FLIGHT & The AIRCRAFT ENGINEER.

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With the current issue a "XMAS GREETING" is included in the form of a coloured section, "Just for Fun."

EDITORIAL COMMENT.

"Newspapers are an essential part of our war organisation."—(*Sir Auckland Geddes, Minister of National Service*).

SPEAKING to the Benchers of Gray's Inn last week, Lord Rothermere, the new Air Minister, delivered himself very definitely on the question of air reprisals. Indeed, his words could scarcely have been more to the point, and were in refreshing contrast to the vague generalities with which the country has hitherto had to rest content. There was no flamboyant talk about "giving the Germans Hell" or any gilded nonsense of the sort—simply a straightforward statement of policy and an equally straightforward explanation of the reasons for the adoption of that policy. In the course of his reply to the toast of the Air Service, Lord Rothermere said:—

Lord Rothermere and Reprisals.

"At the Air Board we are wholeheartedly in favour of air reprisals. *It is our duty to avenge the murder of innocent* women and children. As the enemy elects, so it will be the case of 'eye for an eye, and a tooth for a tooth,' and in this respect we shall slave for complete and satisfying retaliation. General Ludendorff proclaims the war a war of nations, suggesting that the civilian population is as much a mark for the airman's bombs as the fighting man. We detest these doctrines, holding them to be grossly immoral. But in fighting for our lives and the lives of our women and children, we cannot, and we will not, consent to their one-sided application. We have too much at stake in this contest to concede any advantage to a treacherous enemy. He has to learn in this, as in larger things, that it does not pay. We are determined, in other words, that whatever outrages are committed on the civilian population of this country will be met by similar treatment upon his own people."

As an admirably clear explanation of the whole question this would be hard to beat. As we ourselves have so often urged, there can be no weight given to considerations of a sentimental character in the determination of our methods of waging war on Germany. With the Air Minister himself we are completely at one in our hatred of the Hun doctrines of war. We should infinitely prefer the war to be a clean, straight fight between the armies—a war as civilised wars have always been conducted, until the Hun showed that in order to assure the success of his attempt to impose German *kultur* on an unwilling civilisation he was prepared to use any foul, filthy means and to degrade the honourable profession of arms to depths which have not been plumbed even by the most savage cannibal tribes of Central Africa. Whether we like it or not, there can be no question of what we have to do, unless we are content to see our civilians—men, women and children—murdered in their homes with impunity, the while the Hun laughs at us for weaklings and fools. After being compelled to sit down and listen to the platitudes of weak Ministers and pusillanimous Bishops for so many weary months of "nothing doing," we are unfeignedly pleased that at last we have a Minister at the head of the Air Service who intends to carry out the policy of hitting back at the enemy in the way he least desires we should hit him.

The Air Inventions Committee.

A Committee has now been formed, under the above title, for the purpose of investigating all inventions submitted to it and to develop and put into operation any invention which at all promises to add to the efficiency of aircraft. The objects for which this new Committee has been called into being by the Air Minister—we understand that it was the work of Lord Cowdray, by the way—are altogether admirable, and its work will, we are assured, lead to a far greater speeding up of development than would otherwise have been possible. The name of the gentlemen composing the Committee are, in the main, such as to carry confidence to the minds of those having inventions to submit and to that section of the public which has more than a passing interest in the development of aircraft. Its composition may fall somewhat short of the ideal, but on the whole it is such as we can in all fairness commend and welcome. After all, if we invariably waited until the ideal could be attained we should get nowhere, and this is a case which brooked of no further delay.

How far the advance of aircraft construction has been retarded by the want of some such body as this, with full executive powers to operate any inventions which may seem good to them, it is impossible to say. Hitherto, the inventor has not met with conspicuous encouragement unless he has been able to submit an invention which has been at least partially developed. No one is particularly to blame for that, inasmuch as it would be rather too much to expect men and departments engaged on urgent public work to put the latter aside to find time for the investigation of abstract ideas in which there might be much or little as the case might be. But there certainly ought to have existed, long ago, a body similar in scope and composition to the Air Inventions Committee, whose sole concern should have been the investigation of every invention and idea affecting aircraft and their development. However, even if we are as a rule characteristically late in doing these things, we have a knack of doing them rather well when at last we set about them. Let us hope it will prove thus in the case of aircraft inventions.

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Aerial Post to France.

The *Petit Parisien* published the other day the text of an interview with M. d'Aubigny, Deputy-President of the Inter-Ministerial Civil Aeronautic Commission, on the subject of the establishment of an aerial post between France and Great Britain. In the course of the interview he said that the project, which was approaching realisation, would prove of the utmost use during the war, as it would put the members of the Inter-Allied Committee at Versailles into rapid communication with the British Government. The agreement, he said, had been settled in principle, and it was now a matter for the British Government to arrange it definitely. We are almost inclined to think that M. d'Aubigny indulged in a little sardonic humour at the expense of British methods of procrastination, for he ventured the opinion that it would not be long now before the project became accomplished fact, " as the present Air Minister is the brother of Lord Northcliffe, and is known for his promptness in dealing with affairs."

We trust M. d'Aubigny will not be disappointed and that the " brother of Lord Northcliffe " will live up to his reputation and get things moving at once. For our own part, we have no doubt he will, and that in a period measured by days we shall see England and France connected by aerial post. Once the connection is established, we are assured that the link thus created will never be broken, and that it will only be the first in that great chain of aerial services which we look forward to seeing established in the near future, connecting all the civilised States of Europe with the far countries of the earth.

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Another Aircraft Strike.

It really seems to us that a very large section of aircraft workers is simply asking for trouble. Strike follows strike, often on the very flimsiest of pretexts, until we begin to wonder whether there is not more behind the industrial unrest disclosed than a mere desire for betterment of conditions. Following on the strike at Coventry, and that of the sheet-metal workers, a large number of woodworkers " downed tools " at Bristol last week, for, as it seems on the surface, no justification at all. The brief facts seem to be that they had demanded an increase in wages of 12½ per cent. As it is the fashion for every class of industrial worker to constantly demand more wages, there is perhaps nothing in the action of the patriotic workers of Bristol deserving censure so far as that action was confined to making the demand. Apparently the matter was referred to the Ministry of Munitions for its decision. The latter was not as prompt in its compliance with the demand as the men and their leaders considered it should have been, so after allowing some 36 hours' grace after the expiration of the ultimatum, over 2,000 men came out on strike.

There is really nothing in the language adequate to describe the conduct of men who will thus jeopardise the lives of their fellows in the trenches by holding up the production of aircraft on any or no pretext. To say that their action is unpatriotic is a misuse of terms—such a description is totally inadequate to the crime, for it is nothing less. Why is it that if a soldier is found behind the lines in France without his rifle he is regarded as a deserter, court-martialled and shot without ruth, while these deserters of the workships are patted on the head by authority and given anything they like to demand? It simply comes to this, that we take a soldier, who has possibly done his duty manfully and well for many months of danger in face of the enemy—for a shilling a day—and shoot him for an act which was quite possibly one of sudden impulse. On the other hand the man who has been exempted from the dangers of military service, because he is a skilled worker and to whom are paid wages on a scale of which he never dreamed before the war, can plan reasoned desertion *en masse* of his work, which is just as essential to the war as the actual fighting itself. He and his fellows can for any reason or no reason at all drop their tools and leave their work for days or weeks at a time. Logically, of course, we try them by court-martial as deserters from the fighting line—which in fact they are—and shoot them! Not a bit of it. We send down an official from the Labour Commission, and he tells them what good boys they are and how they shall have whatever they want whenever they like to ask for it. That is the way the thing appears to us. There may be another point of view, but if there is we are fain to confess we cannot see it. It is quite possible, we agree, that there are grievances which ought to be remedied, but in none

From a drawing by Major Roderic Hill, M.C.

THE AFTERMATH.—The late Capt. Ball, V.C., on his Nieuport scout, following a smoking wreck which he has shot down to the ground, to find the place where it crashes.

of the recent strikes which have held up aircraft production have we been able to discern any grievance of sufficient magnitude to justify the ultimate course of stoppage of work. If there is much more of this sort of thing we shall become whole-hearted advocates of a policy of embodying all workers—at least those of military age—in essential trades in the military forces of the Crown and thus bringing them within the scope of the Army Act. We have got to win the war, and that is all that matters for the time being. If we cannot get the requisite output of aircraft in one way, it will have to be done in another and that is all there is about it.

By the way, we have mentioned in passing the strike of sheet-metal workers, which gave rise to certain correspondence in the *Times*. We would say, in quoting from this correspondence, we in error referred to Mr. Chas. Marston as being managing director of Sunbeams, Ltd. As a matter of fact, there is no firm of that name. Mr. Marston's business association is with the Sunbeam Cycle Co., which has nothing whatever to do with the Sunbeam Motor Car Co. We make this correction in justice to all concerned.

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The Non-Ferrous Metals Bill.

We confess we are totally unable to understand the bulk of the opposition which was directed in the House of Commons last week against the Non-Ferrous Metal Industry Bill. It may be true that the Bill is not an ideal measure and that it requires strengthening in parts, but there is no question at all as to its merits in the main. Before the war it is notorious that the Germans had obtained almost complete control over certain "non-ferrous" metals, such as lead, spelter and copper which are essential to us in time of peace and absolutely vital in war. If they were essential before the war, they will be doubly so after.

There is a vast amount of reconstruction work to be done, for which these non-ferrous metals will be required in huge and ever-increasing quantity. Then, we shall need further huge amounts for the expansion of our industries, of which the aircraft industry is not one of the least important. As we have said, the Germans had established a practical monopoly over the supply and smelting of these metals, and without some such measure as that under discussion we might have to look forward to a resumption of that monopoly after the war. In speaking on the first reading of the Bill, Sir Arthur Stanley said that "so elaborate is the existing network of organisations, so devious their methods, so tight their hold over the world's markets, so powerful their resources, that an essential preliminary condition of the successful organisation of any counter-measures is to secure that, at all events for a period after the war, all trace of German influence and association, direct and indirect, shall be eliminated from any undertaking allowed to do business in this country."

So far as we are able to read any meaning into this, it means that we were caught in the net spread by Germany before the war, but the Government intends now to give the British metal industries time in which to free themselves from the meshes. Therefore, the Bill provides to give them a period of five years after the war to put their houses in order and to get rid of the German influences which swamped these industries prior to 1914.

As to the wisdom and necessity of this, there is scarcely room for more than one opinion.

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See P. 735

The Bombing of Constantinople.

Mr. Handley Page, the other day, gave to a Press gathering, met to celebrate the bombing of Constantinople by the combination of Handley Page aeroplane and Rolls-Royce engine, a most absorbing account of how the record raid was accomplished. The machine set out from Hendon with the set purpose of dropping bombs on the German battle-cruiser, "Goeben," hiding in the Bosphorus more than two thousand miles away from the starting point. The journey was accomplished *via* Paris, Lyons, Rome, Naples, Otranto and thence across the Adriatic to Salonica. From the latter place the machine was flown to its base and preparations made for the ultimate task of the raid on Constantinople. This was carried out with the most complete success. Approaching its objective at about 2,000 feet, the machine was brought down to 800 feet above the "Goeben," and a salvo of four bombs dropped, which missed the ship but destroyed a submarine lying alongside. Circling round, the pilot, Squadron-Commander Savory, R.N.A.S., brought his machine directly over the hostile battle-cruiser, and four bombs were dropped fairly on her decks. The next objective was the steamer "General," the German staff headquarters, and two bombs were successfully dropped on her. That done, the machine made for the Turkish War Office, on which another pair of bombs was dropped with such success that all the Turkish *communiqué* could say about the damage was that "the War Office was not destroyed."

All this having been accomplished, the gallant airmen set out to run the gauntlet of intense gun-fire on their way back to their base, which was reached in seven hours after the start. Part of the return journey had to be done on one engine, a machine-gun bullet having cut an oil-pipe and partially disabled one motor. The whole thing reads more like a page from a book of adventure than real, sober fact, and not the least wonderful part of it all is that everything was accomplished to schedule time.

There are many lessons to be deduced from the plain, matter-of-fact story told by Mr. Handley Page. Some of these we prefer not to draw at the moment. Others we are more content to dwell upon, because of the earnest they give of the vast possibilities that lie before aerial navigation in the era of peace that we all hope presently will be nearing its dawning. We need say no more than that it was a perfectly wonderful piece of work from beginning to end—a piece of work upon which every one concerned is to be most sincerely congratulated. And not the least reason for congratulation is that all this was accomplished by a purely British machine, with British engines, flown by British airmen, who dropped on a Hun battle-cruiser British bombs promptly to the minute designed before the combination left England on the long flight of more than two thousand miles.

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A Director-General of Aircraft Production.

It was announced on December 12th that the Minister of Munitions had appointed Sir William Weir, Controller of Aeronautical Supplies, to be Director-General of Aircraft Production.

FLIGHT

HONOURS.

"Mentioned in Despatches."

IN the despatch dated November 7th, 1917, from Field-Marshal Sir Douglas Haig, giving a list of names of those whose distinguished and gallant services and devotion to duty he considers deserving of special mention, the following are included :—

Royal Naval Air Service.

Wing Commander E. T. R. CHAMBERS, R.N. ; Flight Lieut. (Acting Flight Commander) R. COLLISHAW, D.S.O., D.S.C. ; Squadron Commander R. S. DALLAS, D.S.C. ; Wing Capt. F. C. HALAHAN, M.V.O., R.N. ; Flight Lieut. C. H. B. JENNER-PARSON ; Flight Lieut. (Acting Flight Commander) R. A. LITTLE, D.S.O., D.S.C. ; Flight Sub.-Lieut. P. G. MCNEIL (killed) ; Flight Sub-Lieut. J. J. MALONE, D.S.O. (killed).

F 4529 P.O. JOHNSON, W. L.

Staff.

Major (Temp. Brig.-General) J. H. W. BECKE, D.S.O., Notts and Derby Regt. ; Bt.-Lieut.-Col. (Temp. Brig.-Gen.) L. B. BOYD-MOSS, C.M.G., S. Staffs. Regt. ; Capt. E. R. L. CORBALLIS, R. Dub. F. and R.F.C. ; Capt. (Temp. Lt.-Col.) E. H. DAVIDSON, M.C., Gor. Hrs. and R.F.C. ; Bt.-Lt.-Col. (Temp. Brig.-Gen.) E. L. ELLINGTON, C.M.G., R.A. ; Bt.-Lt.-Col. (Temp. Brig.-Gen.) J. F. A. HIGGINS, D.S.O., R.A. ; Bt.-Lt.-Col. (Temp. Brig.-Gen.) C. A. H. LONGCROFT, Welsh R. ; Bt.-Maj. (Temp. Brig.-Gen.) G. S. SHEPHARD, D.S.O., M.C., R. Fus. ; Major-Gen. H. M. TRENCHARD, C.B., D.S.O. ; Bt.-Lt.-Col. (Temp. Brig.-Gen.) T. I. WEBB-BOWEN, Bedford R.

Royal Flying Corps.

Capt. (Temp. Maj.) A. B. ADAMS, Spec. Res. ; Lieut. (Temp. Capt.) W. T. L. ALLCOCK, Spec. Res. (killed) ; 2nd Lieut. (Temp. Capt.) J. O. ANDREWS, D.S.O., M.C., R. Scots. Lieut. (Temp. Maj.) J. E. A. BALDWIN, Hrs. ; 2nd Lieut. (Temp. Capt.) B. K. B. BARBER, Northumberland Fus. ; Temp. 2nd Lieut. J. L. BARLOW, Gen. List (killed) ; 2nd Lieut. (Temp. Capt.) H. O. BARNABY, R.F.A. ; Capt. R. J. F. BARTON, R. Sc. Fus. ; Temp. Capt. C. O. B. BEALE, D.S.O., Gen. List ; Temp. Capt. E. M. BETTINGTON, Gen. List ; Temp. 2nd Lieut. (Temp. Capt.) A. W. BIRD, D.S.O., Gen. List ; Temp. Lieut. (Temp. Maj.) J. L. BIRLEY, M.B., R.A.M.C. ; Capt. (Temp. Maj.) W. A. BISHOP, V.C., D.S.O., M.C., Can. Cav. ; Temp. Capt. (Temp. Maj.) R. G. BLOMFIELD, Yeo. (2nd Lieut. D. Gds.) ; Capt. (Temp. Maj.) C. H. B. BLOUNT, M.C., R.W. Surr. R. ; Lieut. H. A. R. BOUSTEAD, Midd'x R. (died of wounds) ; Capt. W. R. BRUCE-CLARKE, Lond. R. ; Capt. (Temp. Maj.) C. E. BRYANT, D.S.O., Hrs. ; Lieut. T. L. F. BURNETT, Spec. Res. ; Temp. Lieut.-Col. Hon. A. S. BYNG, Gen. List.

2nd Lieut. (Temp. Maj.) W. C. CAMPBELL, D.S.O., M.C., Spec. Res. ; Temp. Lieut.-Col. T. W. C. CARTHEW, D.S.O., Gen. List ; Temp. Lieut. H. N. CHARLES, Gen. List ; Capt. (Temp. Lieut.-Col.) A. CHRISTIE, R.A. ; Temp. Capt. D. B. CLEGHORN, Gen. List ; Capt. (Temp. Lieut.-Col.) R. H. COLLIER, Spec. Res. ; 2nd Lieut. (Temp. Capt.) A. CONINGHAM, D.S.O., M.C., Spec. Res. ; 2nd Lieut. J. G. CRANG, Spec. Res.

Sec. Lieut. S. H. A. D'ARCY, D.S.O., Spec. Res. ; Capt. S. L. DASHWOOD, R.E. ; 2nd Lieut. (Temp. Capt.) F. C. DIXON, Dorset R. ; Maj. A. S. W. DORE, Worcs. R. ; Lieut. C. M. DOWN, Herts. ; Lt. (Tp. Capt.) C. DUNLOP, Sea. Hrs.

Bt. Maj. (Temp. Lt.-Col.) W. R. FREEMAN, D.S.O., M.C., Manch. ; Tp. Capt. P. F. FULLARD, D.S.O., M.C., Gen. List.

Capt. C. F. GORDON, M.C., N. Staff. R. ; Temp. Lieut. T. G. GORDON, Gen. List ; Capt. (Temp. Maj.) E. L. GOSSAGE, M.C., R.F.A. ; Temp. Lieut. W. H. GOULDSTONE, Gen. List ; Lieut. E. GRAHAM, Spec. Res. ; Lieut. R. A. GREENWELL, R.F.A. ; Capt. (Temp. Maj.) G. P. GRENFELL, Spec. Res.

2nd Lieut. (Temp. Lieut.) S. A. HARDING, Spec. Res. (died of wounds) ; Maj. (Temp. Lieut.-Col.) J. G. HEARSON, D.S.O., R.E. ; 2nd Lieut. (Temp. Lieut.) R. E. HEATH, Welsh R. Capt. (Temp. Maj.) G. L. P. HENDERSON, M.C., Spec. Res. ; 2nd Lieut. (Temp. Capt.) H. P. L. HIGMAN, R.E. ; Temp. Capt. F. P. HOLLIDAY, D.S.O., M.C. ; Bt. Maj. (Temp. Lieut.-Col.) F. V. HOLT, D.S.O., Oxf. and Bucks. L.I. ; Capt. A. H. C. HOPE, Sea. Highrs. ; Capt. (Temp. Maj.) H. J. F. HUNTER, M.C., Rif. Brig. ;

Maj. L. JENKINS, M.C., R.G.A. ; 2nd Lieut. (Temp. Capt.) W. D. L. JUPP, Spec. Res.

2nd Lieut. (Temp. Capt.) J. S. KEMPER, Lan. R. ; Lieut. (Temp. Maj.) W. J. C. KENNEDY-COCHRAN-PATRICK, D.S.O., M.C., Rif. B. ; Capt. (Tp. Maj.) J. L. KINNEAR, M.C., L'pool R.

Capt. (Temp. Maj.) L. W. LEARMUNT, D.S.O., M.C., Spec. Res. ; Temp. 2nd Lieut. W. F. LEECH, D.S.O. (died of wounds) ; Capt. (Temp. Maj.) J. B. T. LEIGHTON, M.C., S. Gds. (died of wounds ; Qrmr. and Hon. Lieut. (Temp. Major) A. LEVICK ; Lieut. (Temp. Capt.) R. J. LOWCOCK, D.S.O., M.C., Notts and Derby R. ; Bt. Maj. (Temp. Lieut.-Col.) E. R. LUDLOW-HEWITT, M.C., R. Ir. Rif.

Temp. 2nd Lieut. J. W. MADDOCK, Gen. List ; Capt. (Temp. Lieut.-Col.) W. H. C. MANSFIELD, D.S.O., Shrop. L.I. ; Lieut. T. B. MARSON, Yeo. ; Capt. C. G. MARTYN, Mon. R. ; Lieut. (Temp. Capt.) R. P. J. M'COY, Spec. Res. ; Lieut. (Temp. Capt.) P. MIDDLEMAS, Gen. List ; Temp. Lieut. (Temp. Maj.) G. A. N. MITCHELL, R. Fus. ; Capt. (Temp. Lieut.-Col.) W. G. S. MITCHELL, M.C., High. L.I. ; Temp. Maj. A. S. MORRIS, Gen. List.

Capt. (Temp. Lieut.-Col.) C. L. N. NEWALL, Ind. Army.

Temp. Capt. E. B. PALMER, A.S.C. ; 2nd Lieut. (Temp. Lieut.) J. McD. PATTEN, Spec. Res. (killed) ; 2nd Lieut. (Temp. Capt.) S. E. PITHER, K.O. Sco. Bord. ; Temp. Lieut. (Temp. Maj.) C. F. A. PORTAL, D.S.O., M.C., R.E., Spec. Res. ; Lieut. (Temp. Capt.) E. POWELL, Spec. Res. ; Capt. (Temp. Lieut.-Col.) G. F. PRETYMAN, D.S.O., Somerset L.I. ; 2nd Lieut. (Temp. Capt.) H. M. PROBYN, D.S.O., R. War. R. ; 2nd Lieut. (Tp. Lieut.) J. A. PULLAN, Durh. L.I., S.R.

Temp. 2nd Lieut. A. H. C. A. RAWSON, R. War. R. ; Lieut. A. P. F. RHYS-DAVIDS, D.S.O., M.C., Spec. Res. ; Capt. (Temp. Maj.) T. E. ROBERTSON, Spec. Res. ; Capt. (Temp. Maj.) F. M. ROXBY, N. Staffs. R.

Temp. Lieut. W. W. SCOTT-DAVIDSON, Gen. List ; Temp. Capt. C. C. SHARP, Gen. List ; Temp. 2nd Lieut. N. SHARPLES, Manch. R. ; 2nd Lieut. (Temp. Capt.) A. S. SHEPHERD, D.S.O., M.C., Spec. Res. (2nd Lieut. C'wealth Mil. Forces) ; Temp. Lieut. C. K. SHEPHERD, Gen. List ; Lieut. (Temp. Maj.) W. R. SNOW, M.C., Spec. Res. ; Qrmr. and Hon. Lieut. (Temp. Maj.) J. STARLING ; Lieut. (Temp. Capt.) B. E. SUTTON, D.S.O., M.C., Spec. Res., Yeo.

Lieut. (Temp. Capt.) N. TURNER, Spec. Res. ; Temp. Maj. E. J. TYSON, D.S.O., M.C., Gen. List.

Temp. Maj. H. A. VAN RYNEVELD, M.C., Gen. List ; Lieut. (Temp. Capt.) A. H. VINSON, Spec. Res.

Capt. (Temp. Maj.) A. A. WALSER, M.C., Lond. R. ; Temp. 2nd Lieut. C. T. WARMAN, D.S.O., M.C., Gen. List ; Capt. (Temp. Maj.) A. M. WILKINSON, D.S.O., Hamps. R. ; Capt. J. W. WOODHOUSE, D.S.O., M.C., Spec. Res. ; Temp. Maj. C. S. WYNNE-EYTON, Gen. List.

No. 99149 2nd Cl. Air Mech. R. T. Vinsworth ; No. 4616 Sergt. (Flight Sergt.) D. P. ALEXANDER ; No. 3870 1st Cl. Air Mech. S. ANNIS ; No. 8160 Sergt. B. AVENS ; No. 734 Sergt. (Temp, Sergt.-Maj.) BEERE, T. F. ; No. 11099 Corpl. W. P. BERTINAT ; No. 16443 Sergt. W. A. BRIER ; No. 812 Sergt. (Temp. Sergt.-Maj.) G. BROWN ; No. 2466 Sergt. (Acting Flight Sergt.) W. BROWN ; No. 6593 Sergt. (Flight Sergt.) G. A. CRAGEN ; No. 1888 Sergt. (Flight Sergt.) F. L. DORBER ; No. 5403 Sergt. (Temp. Sergt.-Maj.) S. FARROW ; No. 2533 Sergt. (Temp. Sergt.-Maj.) J. F. FORD ; No. 427 Sergt. (Temp. Sergt.-Maj.) A. L. GODDEN ; No. 6802 Sergt. (Flight Sergt.) J. A. GOODALL ; No. 13565 1st Cl. Air Mech. R. W. GREGORY ; No. 7984 1st Cl. Air Mech. A. R. HILL ; No. 143 Sergt. (Temp. Sergt.-Maj.) J. M. KNIGHT ; No. 3807 Sergt. A. J. KURN ; No. 7228 1st Cl. Air Mech. C. H. MCCARTHY ; No. 566 Sergt. D. B. MCFARLANE ; No. 252 Sergt. (Temp. Sergt.-Maj.) D. MARTIN ; No. 684 Sergt. (Flight Sergt.) C. MAYNARD ; No. 9435 Sergt. (Flight Sergt.) H. MILLER ; No. 26240 1st Cl. Air Mech. (Acting Corpl.) P. MONCRIEFF ; No. 4206 Sergt. F. H. PATTERSON ; No. 17062 Sergt. (Temp. Sergt.-Maj.) H. J. PAYNE ; No. 6228 1st Cl. Air Mech. C. PERRY ; No. 11597 Sergt. (Fl. Sergt.) W. J. PINDER ; No. 2274 Sergt. (Temp. Sergt.-Maj.) W. G. REEVES ; No. 27235 Flight Seigt. E. H. RICHMOND ; No. 10752 Sergt. (Flight Sergt.) T. ROBSON ; No. 9287 Sergt. E. J. SLATTERY ; No. 1048 Sergt. (Flight Sergt.) R. STEWART ; No. 10784 Corpl. T. W. THOMPSON ; No. 10989 Corpl. (Acting Sergt.) A. W. TROTTER ; No. 16331 Sergt. J. S. VINER ; No. 8332 Sergt. (Temp. Sergt.-Maj.) J. WHITE ; No. 38605 Corpl. G. WHITEHEAD, Engine Repair Shops ; No. 4312 Sergt. (Flight Sergt.) J. WILKINS ; No. 2100 Sergt. A. J. WILTSHIRE ; No. 9211 Corpl. C. WOOTTON ; No. 3809 1st Cl. Air Mech. W. YOUDE.

Medals for the R.F.C.

IT was announced in the *London Gazette* of December 12th that the King has been pleased to award the Distinguished Conduct Medal to the following for gallanty and distinguished service in the field :—

445 Flight Sergt. H. CAMPBELL, R.F.C.

It was also announced that the King has been pleased to approve of the award of the Military Medal for bravery in the Field to the following non-commissioned officers and men :—

8857 1st Air Mech. C. W. COSGROVE, R.F.C.
958 Sergt. G. W. EDDINGTON, R.F.C.
88166 Corpl. A. W. GEE, R.F.C.
49338 2nd Air Mech. T. H. LEA, R.F.C.
94425 2nd Air Mech. S. L. LEYLAND, R.F.C.
94039 2nd Air Mech. S. MOREMAN, R.F.C.
87808 Corpl. T. TRIESE, R.F.C.
94042 2nd Air Mech. (Act. Corpl.) A. WALTERS, R.F.C.

THE ROLL OF HONOUR.

REPORTED by the Admiralty:—

Accidentally Killed.

Act. Flight Lieut. E. E. Beale, R.N.
Flight, Sub-Lieut. J. L. Moran, R.N.

Died of Injuries.

Act. Flight Commander P. C. D. Douglass, R.N.

Drowned.

737032 Aircraftsman 2nd Class F. T. Sprules, R.N.A.S.

Missing (feared Drowned).

Flight Sub-Lieut. N. I. Larter, R.N.

Missing.

Flight Sub-Lieut. J. G. Clark, R.N.
Flight Lieut. J. F. Dixon, D.S.C., R.N.
Flight Lieut. H. Hall, R.N.

Accidentally Injured.

Prob. Flight Officer, S. Castle-Smith, R.N.
Prob. Flight Officer E. A. J. Pope, R.N.
Prob. Flight Officer M. F. Thwaite, R.N.
Flight Lieut. H. l'E. Tyndale-Biscoe, R.N.

Slightly Injured.

Obsr. Sub-Lieut. W. Hinsley, R.N.

Reported by the War Office:—

Killed.

2nd Lieut. F. A. Biner, R.F.C.
2nd Lieut. G. A. Clayphan, R.F.C.
2nd Lieut. C. E. Coddington, Liverpool, att. R.F.C.
2nd Lieut. L. V. Desborough, R.F.A. and R.F.C.
2nd Lieut. E. G. Dickie, R.F.C.
Lieut. C. H. Dixon, R.F.C.
Lieut. J. A. Pullan, Durh. L.I., attd. R.F.C.
2nd Lieut. F. W. Rhude, R.F.C.
2nd Lieut. A. H. Rice, R.F.C.
Lieut. R. C. G. Rowden, R.F.C.
2nd Lieut. J. H. Stacey, E. Surrey, att. R.F.C.
Lieut. W. M. D. S. Strettell, High. L.I., attd. R.F.C.
Lieut. L. Titchener, R. Lancs., att. R.F.C.
2nd Lieut. G. H. Whyte, R.F.C.
30860 2nd Class Air-Mech. F. Benden, R.F.C.
3085427 Sergt. E. Fletcher, R.F.C.
106015 Pte. D. McNeill, R.F.C.
317 B. G. Russon, Australian F.C.

Previously Missing, now reported Killed.

65251 Sergt. J. F. Carr, R.F.C.

Died of Wounds.

2nd Lieut. E. G. McLeod, R.F.C.
2nd Lieut. E. Pryke, R.F.C.
44685 2nd Class Air-Mech. E. J. Davey, R.F.C.

Previously Missing, now reported Died as Prisoner in Turkish hands.

3318 2nd Class Air-Mech. W. C. Pass, R.F.C.

Wounded.

2nd Lieut. A. E. R. Aldridge, R.F.C.
Capt. H. Brokensha, R.E. and R.F.C.
Lieut. A. Browne, N.Z. Infantry, att. R.F.C.
2nd Lieut. R. Coop, R.F.C.
2nd Lieut. W. T. Fraser, R.F.A., attd. R.F.C.
2nd Lieut. H. E. Galer, R.F.A., attd. R.F.C.
2nd Lieut. C. Gilham, R.F.C.
2nd Lieut. A. Glynne, R.F.C.
2nd Lieut. C. S. Goodfellow, M.C., R.F.C.
Capt. T. Gran, R.F.C.
2nd Lieut. T. R. Hepple, R.F.C.
2nd Lieut. A. M. Kinnear, R.F.C.
Lieut. R. J. H. Linsley, M.C., R.F.C.
Lieut. L. B. Nicholls, A.S.C., attd. R.F.C.
2nd Lieut. N. E. Parkes, R.F.C.
Capt. Hon. J. H. B. Rodney, M.C., Rif. Brig., attd. R.F.C.
Lieut. S. W. Rowles, A.S.C., att. R.F.C.
2nd Lieut. E. L. Shaw, S.Staff.R., attd. R.F.C.
2nd Lieut. C. P. Tiptaft, M.C., Conn.R., attd. R.F.C.
Lieut. H. Townsend, Durh. L.I., attd. R.F.C.

Unless otherwise stated the following are R.F.C. air-mechanics, the figure in brackets indicating the grading:—

A. W. Ford, 43969 (2nd); H. Hardy 15076 (1st); P. V. Hellier 65044 (2nd); C. Blades 24426 (1st); H. Mann 106034 (3rd); R. Millar 27453 (2nd); H. W. Andrew 4919 (1st); F. S. Newson 43984 (2nd); S. H. Platel 25362 (1st); E. H. Simmonds 8685 (1st); G. C. Gretton 9430 (2nd); G. Yates 46481 (2nd).

Previously reported Prisoners, now reported Wounded and Prisoners in German hands.

Lieut. G. W. Mumford, A.S.C., attd. R.F.C.
2nd Lieut. W. C. Smith, R.F.C.
2nd Lieut. N. J. Taylor, R.F.C.

Previously reported Wounded, now reported not Wounded.

47459 2nd Cl. Air-Mech. C. G. Beal, R.F.C.
37316 1st Cl. Air-Mech. A. J. Woodhouse, R.F.C.

Missing.

2nd Lieut. W. Bevan, R.F.C.
2nd Lieut. C. H. Brown, R.F.C.
2nd Lieut. C. B. Campbell, R.F.C.
2nd Lieut. I. D. Campbell, R.F.C.
2nd Lieut. G. A. Cawson, R.F.C.
2nd Lieut. E. V. Clark, R.F.C.
Lieut. A. Dodds, Staff. R., attd. R.F.C.
2nd Lieut. R. E. Dusgate, R.F.C.
2nd Lieut. R. A. Forsyth, R.F.A., attd. R.F.C.
2nd Lieut. J. G. Glendinning, Mon. R., attd. R.F.C.
2nd Lieut. F. B. Gloster, A.S.C., att. R.F.C.
Lieut. A. F. Goodchap, Gloucesters, attd. R.F.C.
2nd Lieut. A. H. C. Hoyles, H.L.I., attd. R.F.C.
2nd Lieut. C. Hyde, R.G.A., attd. R.F.C.
Capt. J. E. Johnston, Ches. R., attd. R.F.C.
Lieut. L. Kert, Rly. Troops, Can. Force., attd. R.F.C.
Capt. D. B. King, R.F.C.
Capt. H. G. E. Luchford, M.C., R.F.C.
Lieut. D. A. D. S. Macgregor, R.F.C.
2nd Lieut. J. Mackenzie, R.F.C.
2nd Lieut. J. F. MacKinnon, R.F.C.
2nd Lieut. W. G. Mann, R.F.C.
2nd Lieut. A. H. Middleton, R. Muns. F., attd. R.F.C.
2nd Lieut. D. Miller, R.F.C.
2nd Lieut. G. Noon, Sher. For., attd. R.F.C.
2nd Lieut. J. T. Orrell, R.F.C.
2nd Lieut. G. G. W. Petersen, R.F.C.
2nd Lieut. S. G. Spiro, R.F.C.
2nd Lieut. L. W. Timmis, R.F.C.
Capt. R. T. Towsend, Can. A.P.C., attd. R.F.C.

Previously Missing, now reported Prisoners in German hands.

2nd Lieut. P. Goodbehere, Manch. R., attd. R.F.C.
2nd Lieut. N. H. Kemp, R.F.C.
Capt. H. Patch, Lan. R., attd. R.F.C.
2nd Lieut. E. A. L. F. Smith, R.F.C.
2nd Lieut. R. M. Smith, R.F.C.

Prisoners in German hands.

103362 2nd Cl. Air-Mech. W. Nicol, R.F.C.
88145 1st Cl. Air-Mech. F. Pollitt, R.F.C.

Correction: **Missing.**

2nd Lieut. J. P. Dalley, I.A.R.O., attd. R.F.C., *should read* Lieut. J. P. Dalley, I.A.R.O., attd. R.F.C.

An Air Inventions Committee.

ONE of the last acts of Lord Cowdray as Air Minister was the appointment of an Air Inventions Committee, which is composed as follows:—Mr. Horace Darwin, F.R.S., chairman; Major-General Luck, C.B., C.M.G., vice-chairman; Sir Dugald Clark, K.B.E., F.R.S.; Sir Richard Glazebrook, F.R.S.; Professor H. L. Callandar, F.R.S.; Professor C. H. Lees, F.R.S.; Professor J. E. Petawel, F.R.S.; Mr. L. Bairstow, C.B.E., F.R.S.; Lieut.-Commander Wimperis, R.N.V.R.; Major G. L. Taylor, R.F.C.; Captain B. M. Jones, R.F.C.; Captain A. V. Hill, Munitions Inventions Department; Mr. J. P. Millington; and Mr. F. W. Lanchester.

The function of the committee will mainly be to investigate all inventions submitted to it, and will develop and put into operation as soon as possible any invention which at all promises to add to the efficiency of aircraft.

Communications regarding inventions or ideas should be forwarded to the Air Inventions Committee, No. 2, Clements Inn, W.C. 2.

The "X 84" Raid.

IT was officially announced on December 14th that the two German aeroplanes brought down during the raid on the morning of December 6th, were both hit by anti-aircraft guns, and were forced to descend owing to the injuries received.

FLIGHT

THE 230 H.P. BENZ AERO ENGINE.

(*Concluded from page* 1312.)

Water cooling.—The centrifugal water pump is situated on the top of the rear end of the crank chamber, and the vertical spindle of the rotor is driven by bevel gears off the camshaft intermediate pinion.

The speed of the water pump spindle equals 1.58

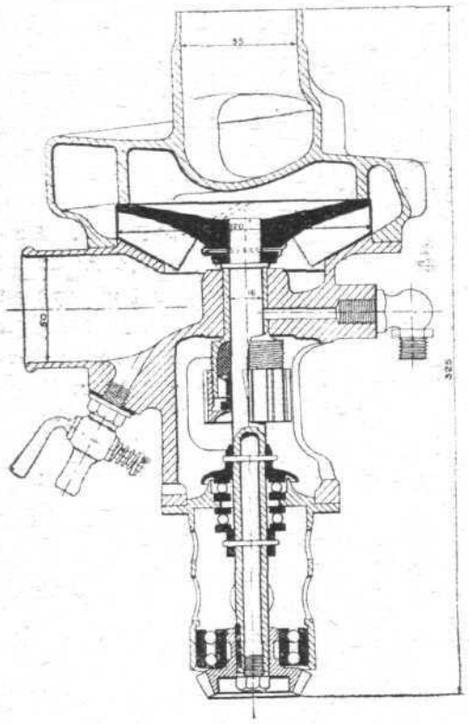


Fig. 20.—Arrangement of water pump.

to 1 of the crank shaft and the diameter of the rotor equals 120 mm.

The diameter of the water inlet to the pump is 50 mm. and the diameter of the outlet is 55 mm. The water enters at the top of the rear cylinder through the steel tub elbow, and as previously mentioned is deflected on to the exhaust passages of each cylinder. The pump spindle is fitted with a double thrust ball race and is provided with a large stuffing gland, and the spindle is lubricated by a grease lubricator operated from the pilot's seat.

From a test of this water pump carried out at the Royal Aircraft Factory, with the pump removed from the engine and coupled to an electric motor, the following results were obtained:—Running at an average speed of 2,100 r.p.m., equivalent to 1,325 r.p.m. of the crankshaft. The maximum delivery equals 120 gallons per minute with free outlet, and the minimum delivery equals 48 gallons per minute against a pressure of 7 lbs. per square inch.

The complete water cooling system is given in the diagrammatic sketch (Fig. 30), which shows the connections between the cylinders, water pump and the twin radiators, and also the small water tank which is attached to the top plane of the machine. From this it will be seen that the greater part of the water is forced by the pump directly through the cylinder heads in series, whilst the bottom portion of the cylinder water jackets is supplied through a branch pipe from just above the outlet of the water pump. This branch pipe is also connected to the carburettor water jackets as shown in the diagram.

The water connections between the heads of the cylinders are rubber rings which are contracted into the semi-circular joints by steel band clips of ingenious design. The clips are made of thin strips of annealed spring steel; these are wound twice round the rubber rings and fastened by small steel links and bolts. In starting to make this joint the end of the steel band is first bent over the bottom bar of the connecting link and then wound twice round the rubber ring, the free end of the steel band passing through the centre portion of the connecting link on the second winding. The end of the steel band is then fastened to the top end of the link by coiling the end several times round a small bolt in the head of the link, the end of the steel band being bent over for about 2 mm. and inserted into a slot cut in the bolt, so that by turning the bolt in the link the steel band is wound tightly round the ring joint and, owing to the position and shape of the link, remains fixed.

The water capacity of each cylinder jacket equals

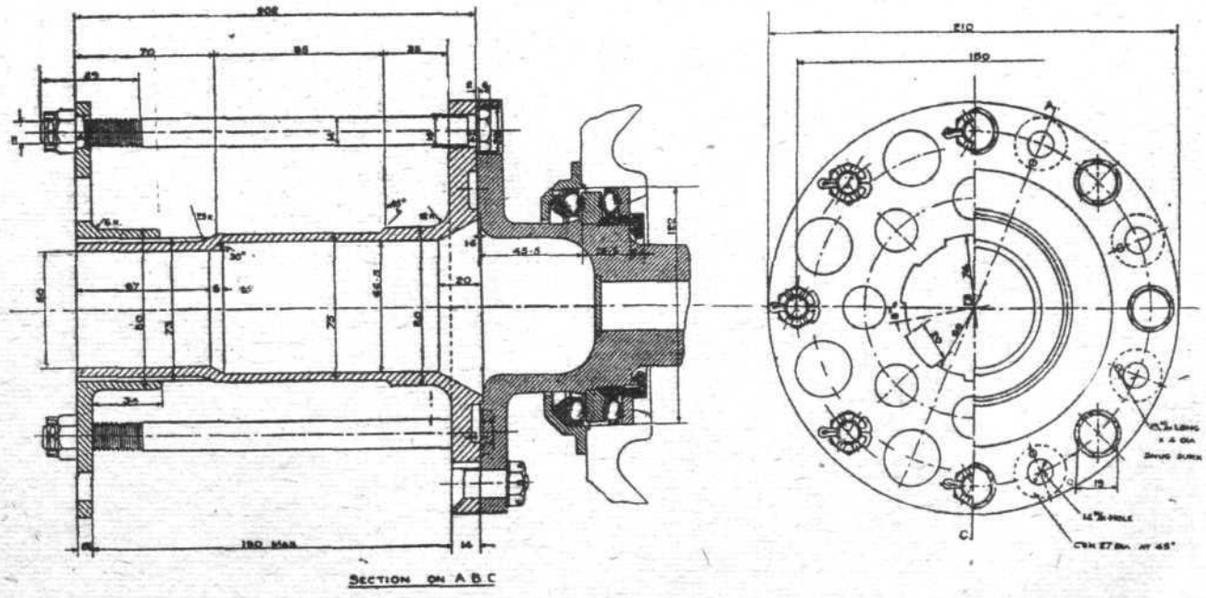


Fig. 21.—Arrangement of propeller boss and thrust race.

1,873 c.c., and the total amount of water carried in the engine without radiators equals 30.9 lbs.

Two rectangular honeycomb radiators are fitted, one on each side of the machine.

The Petrol Pump.

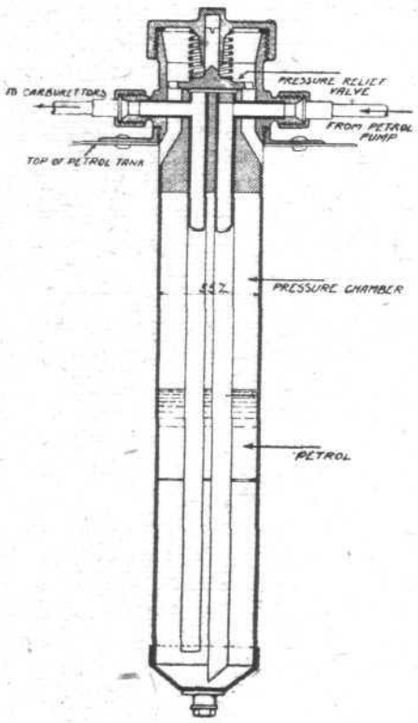
The automatic petrol pumps, which have recently been fitted, constitute one of the most interesting features of the 230 h.p. Benz engines. Its function, of course, is to supply petrol under pressure to the carburettor without the disadvantages of using petrol tanks under pressure. The pump is used in conjunction with a supplementary pressure reservoir inside the main petrol tank, as shown in the diagrammatic sketch (Fig. 25). The system includes an auxiliary petrol tank and semi-rotary hand pump.

Constructional details of the device are shown in the general arrangement of the pump (Fig. 23), and the functions and operation of the pump and the supplementary pressure reservoir are explained in the diagram.

The petrol pump consists of a small piston of cast iron, 40 mm. diameter, working in a cylinder or sleeve of phosphor-bronze, open at both ends. The piston is arranged below the crank, and the lower portion of its cylinder extends nearly to the bottom of a chamber which contains a determined quantity of castor oil. The piston is operated by a small connecting rod, which is driven through worm gears by a spindle forming an extension of the inlet camshaft.

Referring to the drawing of the pump and the diagram, the working principle of the device is as follows :—

Petrol in the main tank enters the petrol pump through the filter at the side of the pump and, on the upward stroke of the piston, with the corres-



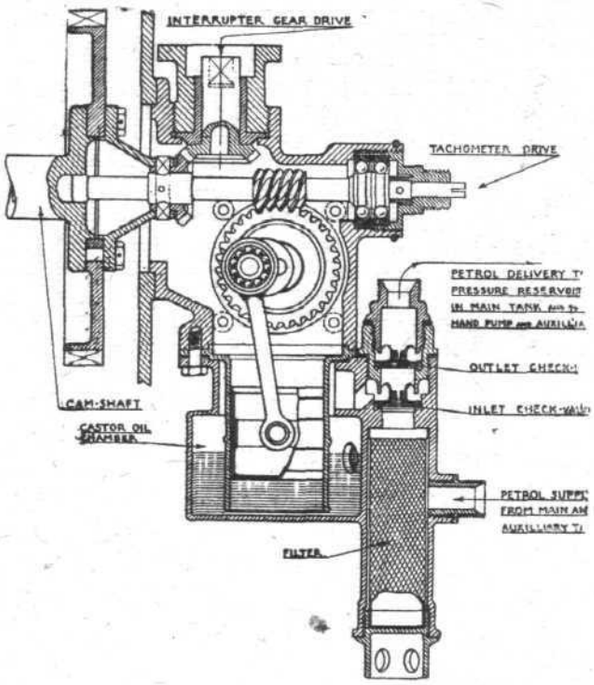


Fig. 23.—Arrangement of petrol pump and section through pressure reservoir.

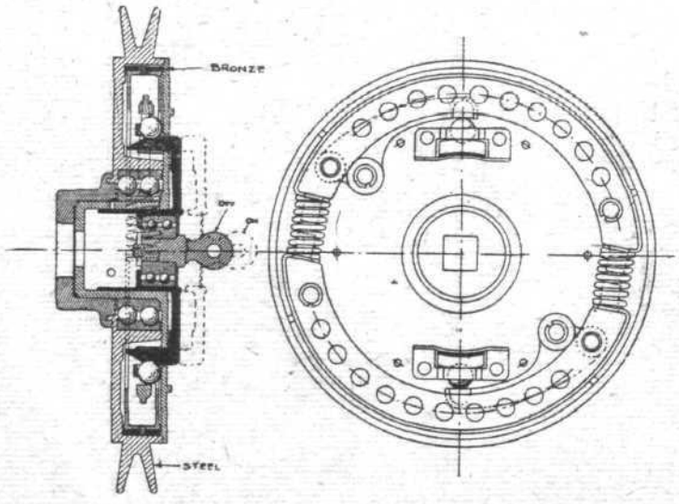


Fig. 22. — Arrangement of wireless drive friction clutch.

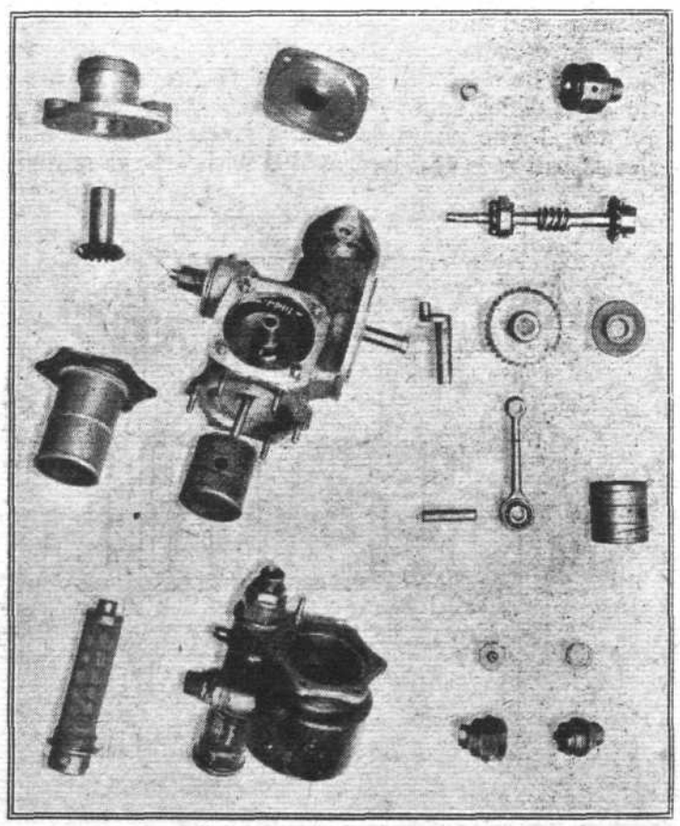


Fig. 24,—Component parts of petrol pump.

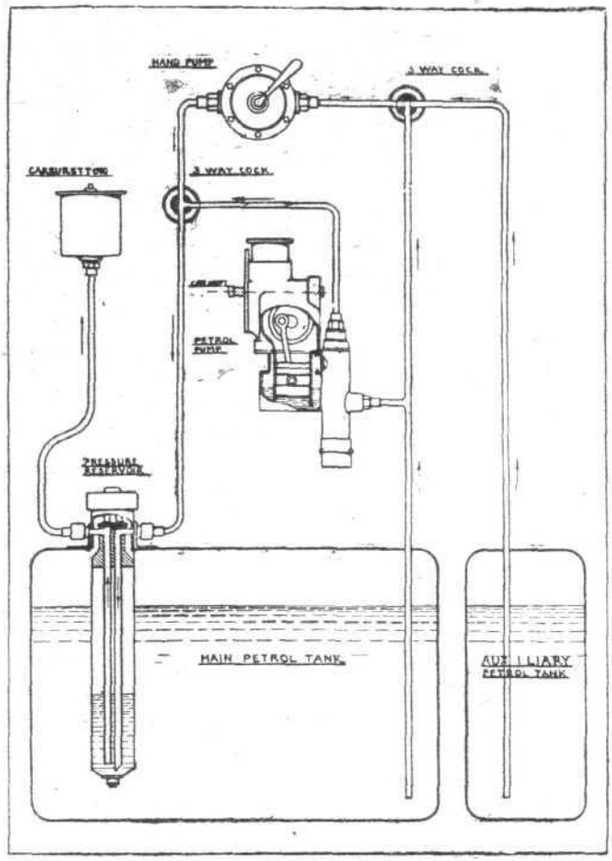


Fig. 25.—Diagram of petrol systems used in conjunction with petrol pump.

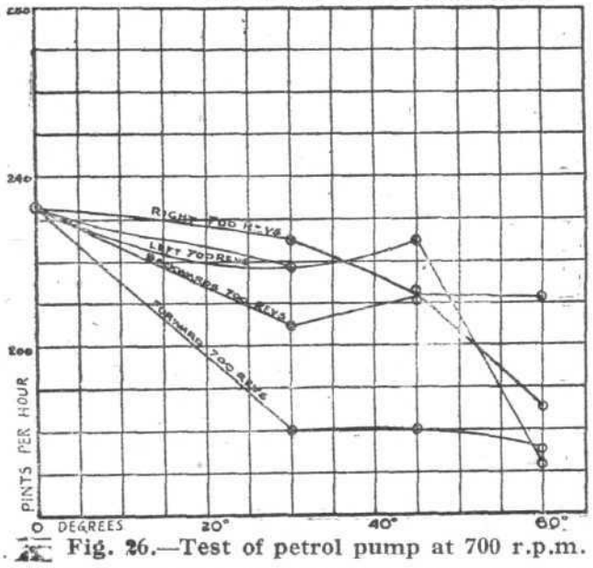


Fig. 26.—Test of petrol pump at 700 r.p.m.

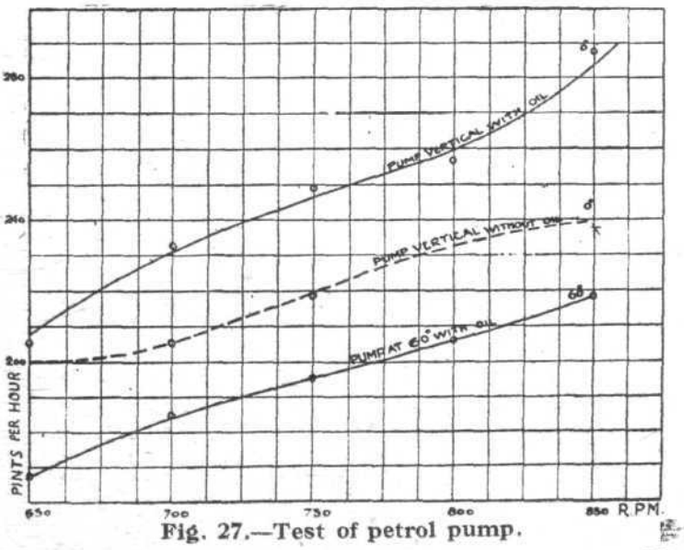


Fig. 27.—Test of petrol pump.

ponding falling of the castor oil, the petrol is drawn into the annular chamber through the inlet or lower check valve. Upon the downward stroke of the

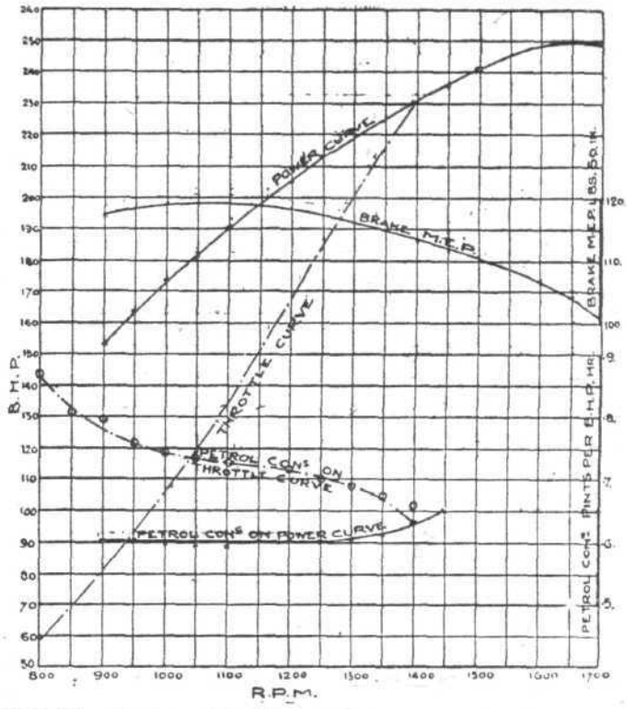


Fig. 28.—Power, throttle, and consumption curves.

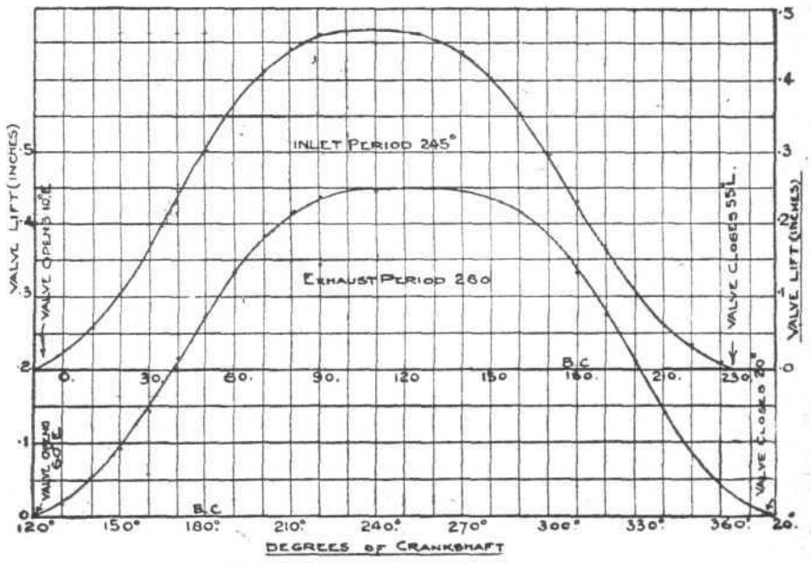


Fig. 29.—Valve lift diagram.

piston, the petrol charge, above the castor oil seal, closes the inlet check valve and forces the charge out of the upper valve. The volume of petrol discharged at every stroke corresponds, of course, to the displacement of the oil by the stroke of the piston.

From the delivery of the pump, petrol is forced through a pipe into the top of the pressure reservoir inside the main petrol tank, and rising in the reservoir creates a cushion of compressed air above the petrol in the reservoir, thus serving to damp out the pulsations conveyed to the petrol by the action of the pump. From the bottom of the pressure reservoir the petrol is forced upwards through the shorter of the two pipes inside the reservoir, and is delivered under an even pressure to the carburettors.

A relief pressure valve is fitted to allow excess petrol to return to the main petrol tank through twelves holes drilled in the head casting of the pressure reservoir.

As illustrated in the diagrammatic drawing of the petrol system, a supplementary petrol system is used, employing an auxiliary petrol tank and a semi-rotary hand pump in conjunction with the main system.

Two three-way cocks are fitted, as shown, which allow any one of the following three systems to be used, viz. :—

(*a*) Main petrol pump from main tank.
(*b*) From main tank by hand pump.
(*c*) By hand pump from auxiliary tank.

The driving spindle of the petrol pump also drives a vertical spindle through small bevel gearing, which operates the interrupter gear for the machine guns. To the rear end of the pump spindle is fitted the flexible tachometer drive.

In the earlier types of petrol pumps fitted to the Benz engines, the castor oil chamber was provided with an oil-filling cup. This was screwed into the side of the chamber casting, and was fitted with a special form of drain cock to determine the quantity of oil poured into the pump. This filling arrangement has now been given up and the annular oil chamber fitted with a drain plug only. The speed ratio of the driving spindle to the small crankshaft driving the piston of the petrol pump equals 10.75 to 1.

The bore of the pump equals 40 mm. and stroke equals 26 mm. Lift of valves (inlet and outlet) equals 2 mm. Volume of petrol delivered at each stroke of pump equals approximately 2 cub. ins.

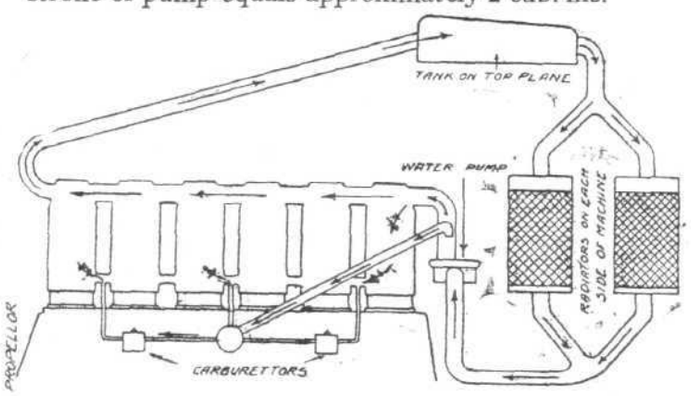


Fig. 30.—Diagram of water-cooling system.

The weight of the complete petrol pump equals 6.75 lbs.

Test results of this petrol pump carried out recently at the Royal Aircraft Factory are given in the following report :—

Effect of Angle.—The normal consumption of this engine is approximately 150 pints per hour at normal speed, and the pump has a greater delivery than this at any angle up to 60° in any direction.

Delivery.—Maximum : 288 pints per hour at 10 lbs. per square inch pressure when the pump was vertical and running at 850 r.p.m. At normal speed, *i.e.*, 700 r.p.m., the delivery is 233 pints per hour. At speeds in excess of 750 r.p.m. the inertia of the fluid columns causes displacement of the castor oil.

Running without castor oil.—The pump was run for 10 minutes with the piston in direct contact with the petrol, with no deleterious effect.

A number of tests have been carried out to determine the rate of flow, also the inlet and outlet pressures of the pump, while tilted at the angles which are likely to occur when the machine is in flight while banking to the right and left, diving and climbing. Readings obtained as a result of the tests are tabulated on following page.

The accompanying graphs (Figs. 26 and 27) show :—

(i) The delivery of the pump over a certain range of speeds, the angles denoting the positions at which the pump was set.

(ii) The delivery at constant revolutions while working at angles of plus or minus 60°.

The maximum delivery obtained from the pump was 288 pints per hour. This was obtained at a pressure of 10 lbs. per square inch when the pump was vertical and running at 850 r.p.m. In no case does the delivery fall below 160 pints per hour. A test was also carried out on the pump without castor oil. Under these conditions the pump was run successfully for about ten minutes, after which the test was stopped.

R.A.F. REPORT ON CHEMICAL ANALYSIS OF PARTS OF 230 H.P. BENZ ENGINE.

	Carbon. %	Silicon. %	Sulphur. %	Phosphorus. %	Manganese. %	Nickel. %	Chromium. %
Water jacket	0.07	0.03	0.246	.0027	0.35	Nil	0.02
Crankshaft	0.13	0.31	0.026	.0014	0.48	3.21	0.87
Connecting rod ..	0.15	0.21	0.027	.0026	0.37	4.02	1.21
Gear wheel	0.23	0.25	0.014	.0027	0.53	3.58	0.81
Camshaft	0.14	0.23	0.029	.0026	0.95	4.68	1.48
Inlet valve	0.26	0.28	0.012	.0020	0.40	5.36	1.06
Valve spring	.040	0.02	0.033	.0085	0.55	Nil	0.01

	Graphitic Carbon. %	Combined Carbon. %	Silicon. %	Sulphur. %	Phosphorus. %	Manganese. %
Cylinder	1.90	0.77	1.68	0.122	0.176	0.48
Piston	1.85	0.50	1.46	0.130	0.210	0.77

	Graphitic Silicon. %	Combined Silicon. %	Iron. %	Tin.	Copper. %	Zinc. %	Lead.	Aluminium. %
Crank-case	0.18	0.89	0.93	Trace	6.20	9.59	Trace	82.21 by diff.

	Antimony. %	Tin. %	Copper. %	Lead. %
Bearing metal	11.95	78.57	8.10	0.90

The analyses of gear wheel and camshaft were made on drillings taken from the cores, as these were case-hardened parts.

Mechanical tests gave results as under :—

	Yield Point. Tons per sq. in.	Ultimate Stress. Tons per sq. in.	Elongation. %	Reduction of Area. %	Impact. Ft./lbs.
Crankshaft ..	55.2	62.5	21.3	59.75	26
Cylinder ..	—	8.36	Nil	Nil	—
Connecting rod	41.9	48.1	14.0	—	—
Crank-case ..	—	8.91	—	—	—

Paris—London Aerial Post.

INTERVIEWED by the *Petit Parisien*, M. D'Aubigny, Deputy President of the Inter-Ministerial Civil Aeronautic Commission, has stated that the project for the establishment of a postal aerial line between France and Great Britain, which was approaching realization, would be very useful, as it would put the members of the Inter-Allied Committee at Versailles into rapid communication with the British Government. He also said that the idea was conceived before the Rapallo agreement, and M. Flandin was entrusted with a mission to the British Government to consult with the Air Board. At the same time, the Minister of Commerce empowered the Director of the Postal Services to negotiate with the Fost Office for a postal convention. The agreement in principle has been settled, and it is now a matter for the British Government to arrange the definite agreement.

FLIGHT

THE DOPPLER EFFECT.

By A. E. WATSON and G. H. MAKEY.

[A short time age we published in these columns a short article on this subject by Lieut. Back. After going to press with Lieut. Back's article—but before its appearance—we received one written by Messrs. A. E. Watson and G. H. Makey on the same subject. Further, in the interval between publication of the two articles we have received the following comments on the article by Lieut. Back, which it seems well to publish; together with the article, since in this manner readers will be able to see more clearly the bearing of the points criticised. The comments and article by Messrs. Watson and Makey are printed below.—ED.]

In an article on "Doppler's Principle," by Lieut. N. Back, appearing in the issue of "FLIGHT," No. 467, dated December 6th, 1917, the author has apparently fallen into certain errors due to confusion between the two cases of a moving source of sound with a stationary observer, and a stationary source of sound with a moving observer. Thus, the second paragraph states: "Only when an aeroplane is at an infinite distance will the sound waves reach the observer with the velocity of sound plus the velocity of the plane approaching or minus the velocity of the plane receding," whereas, with the observer stationary, the sound waves always reach the observer with the velocity of sound, unaffected by the velocity of the aeroplane. The velocity of arrival is only affected when there is relative movement between the observer and the air. When the source of sound is moving, the observer being stationary in still air, the frequency of the note heard is $\frac{nV}{V-v}$ when the source is approaching the observer, and $\frac{nV}{V+v}$ when it is receding—where n is the true frequency, V the velocity of sound, and v the velocity with which the source is approaching or receding. On the other hand, when the source of sound is stationary in still air, and the observer moving, the frequency of the note heard is $\frac{n(V+v)}{V}$ when the observer is approaching the source with a velocity v, and $\frac{n(V-v)}{V}$ when he is receding from the source. The notes heard are therefore not the same in the two cases, although the musical interval between the higher and lower note is the same in each case, viz., $\frac{V+v}{V-v}$. In Diagram 2 of Lieut. Back's article, v has been plotted vertically above and below the horizontal line through O. The curves obtained are therefore those having ordinates $\frac{V \pm v}{V}$, the ordinate of the point O (which ordinate would correspond to the true frequency) being V. This ordinate is not shown, but on the scale of the diagram would extend some 12 ins. below O, so that to interpret Diagram 2 in terms of frequency, the ordinates of the curves given should be measured from a horizontal axis lying this distance below the horizontal line through O. Diagram 2 would then agree with the case of a stationary source of sound, and an observer moving along a straight path at 80 m.p.h., but does not agree with the case of a moving source of sound and a stationary observer. The correct curves would bear a general resemblance to those given in Diagram 2, but would not be symmetrical about the horizontal through O as shown.

The article concludes by insisting "that only when the actual velocity of the plane through the air is rapidly increasing and the plane is diving along the line of sight, could the note ever be heard to *rise*." This is by no means a general truth, but only holds when the source of sound is confined to a straight path. The note heard falls or rises according to whether the velocity of approach (*i.e.*, the velocity component of the source towards the observer) is decreasing or increasing. Thus, with the source moving with constant or even decreasing velocity, it is possible so to shape the path along which the source moves that the velocity component towards the observer shall increase, and the note heard rise. An example of this is found in the circular path of the source of sound as dealt with in our article.

A. E. W.
G. H. M.

THE Doppler Effect, according to which the frequency or pitch of a note as heard differs from the true pitch of the note as emitted by the source of the note, is due to one or both of two causes, namely, relative movement between the source and the medium and relative movement between the observer and the medium. The former affects the velocity with which the sound waves move away from the source. In general this velocity is different in different directions, and is given, in any particular direction, by the algebraic difference between the velocity of sound through the medium and the component of the relative velocity of source and medium in the given direction. The frequency of the note heard is inversely as this algebraic difference measured along the line joining the source and the observer, and is independent of whether relative movement between source and medium is due to actual movement of the source, or of the medium, or both. The second cause affects the velocity of arrival of the sound waves at the observer. The frequency of the note heard is directly as the velocity of arrival measured along the line joining source and observer, and is independent of whether the relative movement between the medium and the observer is due to actual movement of the medium, or of the obsserver, or both. Thus taking the simple case of the medium at rest, the source moving with a velocity component v_s towards the observer, and the observer moving with a velocity component v_o towards the source. Let V be the velocity of sound through the medium, and n the true frequency or number of vibrations in unit time emitted by the source. The velocity of the sound relative to the source is $V - v_s$, the velocity of arrival at the observer $V + v_o$, and the frequency of the note heard $n\frac{V+v_o}{V-v_s}$. When the observer is at rest $v_o = 0$ and the frequency heard is $\frac{nV}{V-v_s}$. With the source at rest, $v_s = 0$ and the frequency heard is $\frac{n(V+v_o)}{V}$.

In the present article it is proposed to examine somewhat fully the case in which there is relative movement only between the source and the medium, and for simplicity we will assume the actual movement to be one of the source through the medium at rest. Imagine a point source of sound to be moving with uniform velocity v along a straight path AB, Fig. 1, the observer being stationed at O. Considering the note emitted between any two points D, E, draw OC perpendicular to AB and join DO, EO. We may call C the "pedal" point of the path and OC ($= h$) the shortest distance of the path from the observer. Putting s for EC, the distance of E from the pedal point, and S_1 for DC, the time occupied by the emission of the note is $\frac{S_1 - s}{v}$. If, in this time, N sound waves, not necessarily of the same length, are emitted, the average frequency of the emitted note is $\frac{Nv}{S_1 - s}$. If the sound waves are of the same length, the average frequency is identical with the true frequency, n say. Now the

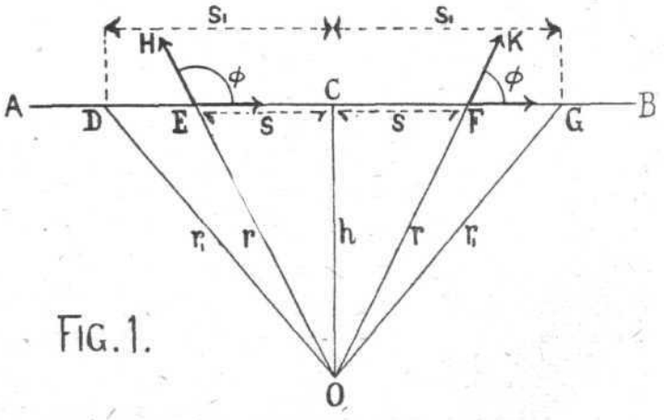


FIG. 1.

initial impulse of the group of waves has to traverse the path DO to reach the observer, and the final impulse has to traverse the path EO. If these two paths were equal, the period of emission of the waves would be the same as the period of

reception, and the average frequency of the notes emitted and heard would be the same. As it is, however, the path $EO_1 (= r)$ is shorter than the path DO $(= r_1)$, so that the final note as heard to the average frequency of the note emitted is $\frac{V(s_1 - s)}{V(s_1 - s) + v(r_1 - r)}$ which becomes, when the path FG is

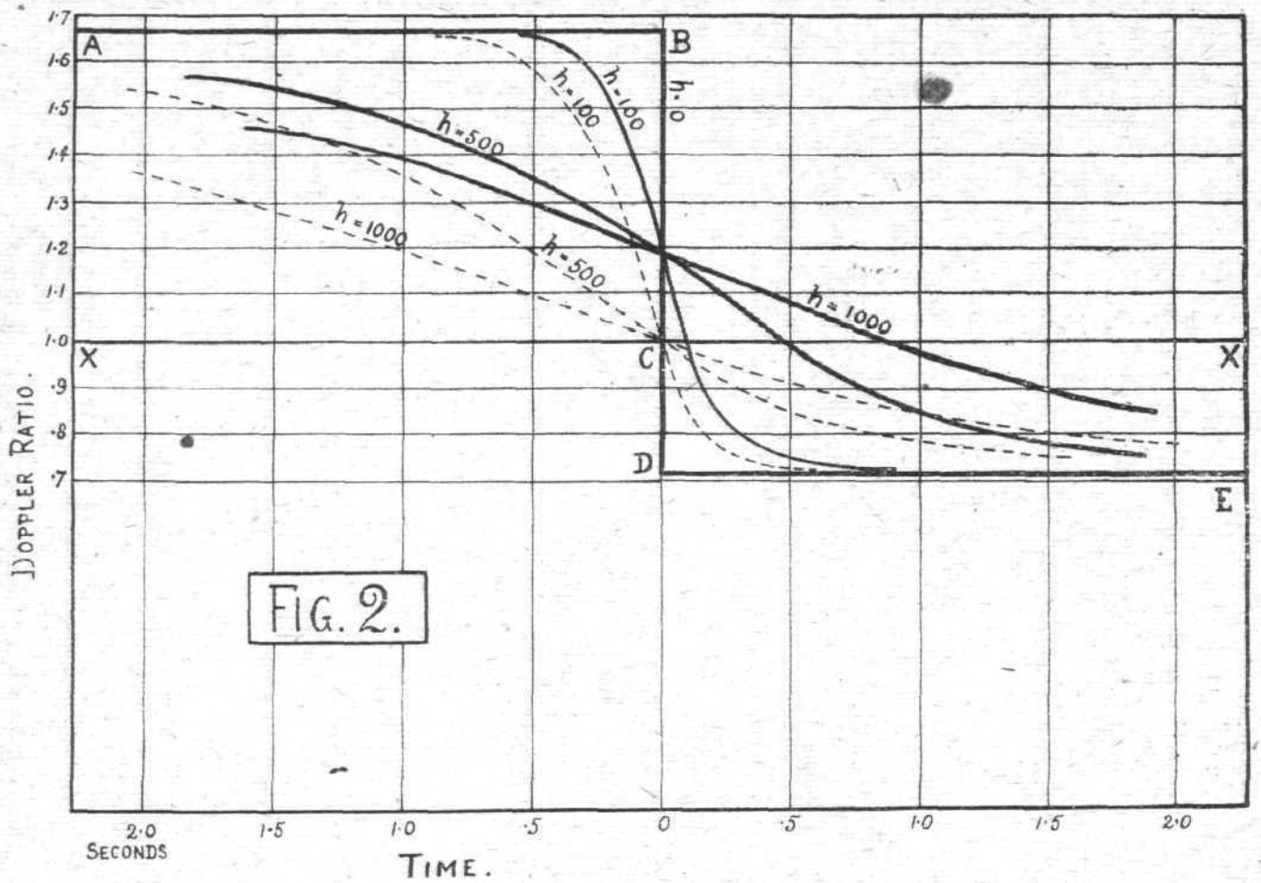


FIG. 2.

impulse overtakes the initial impulse by a period of time $\frac{r_1 - r}{V}$. The time of arrival of the whole note is shortened by this amount so that the N waves emitted reach the observer in a time $\frac{s_1 - s}{v} - \frac{r_1 - r}{V}$. The average frequency of the note heard is therefore $\frac{NvV}{V(s_1 - s) - v(r_1 - r)}$. The ratio of the average frequency as heard to the average frequency as emitted is therefore

$$\frac{V(s_1 - s)}{V(s_1 - s) - v(r_1 - r)}. \qquad (1)$$

This ratio is greater than unity, *i.e.*, the note heard is higher than the note emitted. When D is so close to E that DE is infinitesimal, $(s_1 - s)$ becomes ds and $(r_1 - r)$ becomes dr. Expression (1) then becomes

$$\frac{V}{V - v\frac{dr}{ds}} \qquad (2)$$

Now $r^2 = s^2 + h^2$, whence $r\,dr = s\,ds$ or $\frac{dr}{ds} = \frac{s}{r} = \cos CEO$.

Substituting this value, (2) becomes

$$\frac{V}{V - v\cos CEO}. \qquad (3)$$

Now if we produce OE to H and put ϕ for the angle HEC between the line OE produced and the line EC drawn from E in the direction in which the source is moving, we have $\cos\phi = -\cos CEO$. We may therefore write (3) in the form

$$\frac{V}{V + v\cos\phi}. \qquad (4)$$

Now consider the case in which the source is moving away from the pedal point, the note being emitted between two points F, G. Let $CG = S_1$, $CF = S$, $OG = r_1$ and $OF = r$. In this case the termination of the note has to traverse a path r_1 longer than the path r traversed by the initial impulse. The termination of the note therefore lags behind and the time of arrival is increased by the period $\frac{r_1 - r}{V}$. The time of emission is $\frac{s_1 - s}{v}$, and therefore the time of arrival is $\frac{s_1 - s}{v} + \frac{r_1 - r}{V}$.

Proceeding as before, the ratio of the average frequency of the infinitesimally short, so as to approximate in magnitude to a point,

$$\frac{V}{V + v\cos CFO}. \qquad (5)$$

Producing OF to K and putting ϕ for the angle KFG, we have $\cos CFO = \cos\phi$. Substituting, expression (5) becomes $\frac{V}{V + v\cos\phi}$ which is identical with (4).

With a little reflection the reader will see that we cannot, with accuracy, talk of the frequency of the note emitted by the source in passing a point in its path, because the time the source is at any point is so short that only an infinitesimal part of a single wave-length can be emitted there. Expression (5) does not therefore, strictly speaking, represent the ratio of

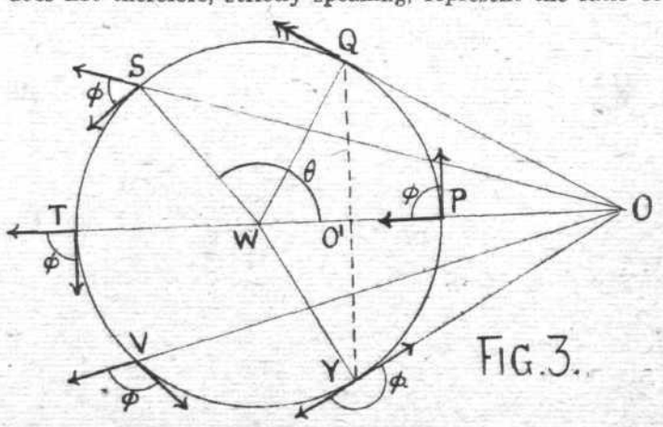


FIG. 3.

the frequency as heard to the frequency as emitted, of a note emitted at a point in the path of the source. It represents the limiting value of the ratio $\frac{\text{time of emission}}{\text{time of arrival}}$ when the time of emission becomes vanishingly small. For this reason we shall call expression (5) the Doppler Ratio and denote it by the letter R. When we are dealing with a finite portion of the path of the source, such as DE, expression (1) is the average value of the Doppler Ratio for the portion of the path under consideration. When the finite portion of the path con-

sidered is so small that the Doppler Ratio does not vary much throughout, or when the ratio varies uniformly, we should, in practice, make small error in taking R at the middle point of the path considered as the average value, *i.e.* as the ratio $\frac{\text{average frequency of note heard.}}{\text{average frequency of note emitted.}}$

For given values of V and v we see from (4) and (5) that the value of R for any point of the path depends upon ϕ. The angle ϕ, as a matter of fact, is a useful general criterion. When ϕ is obtuse, as at E, R is greater than unity, when ϕ is a right angle, as at C, R is unity, and when ϕ is acute R is less than unity. Also, if ϕ is decreasing, $\cos\phi$ is increasing and R is falling. When ϕ is increasing, R is rising. The maximum possible range of variation of ϕ is between zero and two right angles. It should be noted that the above criterion applies equally well to a source moving in any path, straight or curved, and not necessarily in one plane, provided that ϕ is measured in the manner indicated and v is constant. If we imagine the source of sound to travel in a straight path from an infinite distance to the left of A, to an infinite distance to the right of B, we see that ϕ continually decreases from two right angles to zero, and consequently R decreases continuously from $\frac{V}{V-v}$ to $\frac{V}{V+v}$. From this we see that (except in a single particular case to be dealt with immediately) a constant note emitted by a source moving with uniform velocity along a straight path is heard as a *continuously falling* note. Since $\cos CEO = \frac{s}{r}$ and $\cos CFO = \frac{s}{r}$ we may write expressions (3) and (5) together in the form $\frac{V}{V \pm v\frac{s}{r}}$, the negative value of $\frac{s}{r}$ being used when the source is moving towards the pedal point C, and the positive value when moving away from C. Also, since $r = \sqrt{s^2+h^2}$ $R = \frac{V}{V \pm v\frac{s}{r}} = \frac{V}{V \pm \frac{vs}{\sqrt{s^2+h^2}}}$.

From this form of the expression we see that, for any value of s, as h is increased the value of $\frac{s}{r}$ is decreased and R approximates more and more to unity, until, when h is infinite $v\frac{s}{r}$ vanishes and $R = 1$. That is to say, the further the observer is from the pedal point the less marked is the variation in R for any given variation in s, the distance of the source from the pedal point. On the other hand, when $h = 0$, so that the source is moving directly towards or away from the observer, $\frac{s}{r} = 1$ for all values of s. The frequency of the note heard under these circumstances is therefore constant and $= \frac{nV}{V-v}$ as the source is approaching, and again constant and $= \frac{nV}{V+v}$ as the source is receding. At the pedal point, ϕ changes *suddenly* from two right angles to zero, and the change in R takes place suddenly at the instant the source is passing *through the observer*. Obviously, this sudden change can never be heard in practice. The case just considered is the particular case referred to above. To aid in forming a mental picture of the above results the curves, Fig. 2, have been prepared, showing variations in R with passage of time. Time has been measured backwards and forwards from the instant at which the source passes the pedal point of the path, and curves have been drawn for the values $h = 0$, 100, 500, and 1,000 feet. V has been taken as 1,100 feet per second, and v has been given the rather high value of 440 feet per second. The reason for this high value is that the lower the value of v the more nearly the maximum and minimum values of R approximate to unity. Thus with v = 88 ft. per sec., or 60 miles an hour, R varies between the values $\frac{1,100}{1,100 \pm 88}$ = 1.08 and .92. This variation is too small to admit of being shown clearly on a scale suitable for reproduction. With v = 440 ft. per sec. the maximum and minimum values of R are 1.67 and .71, the musical interval being somewhat greater than an octave. Knowing v, we know the distance s of the source from the pedal point at any time measured from the instant the source is at C. For example s = 220 ft. half a second before, and after, passing C. R has been calculated and plotted for a number of points along the path, the results yielding the dotted line curves. It will be seen that, when $h = 0$, R is constant (=1.67) until the pedal point is reached, where a sudden fall takes place to the value R = .71, as indicated by the curve $ABDE$, Fig. 2. With increasing values of h, the fall becomes more gradual, but is always most rapid at C, at which point R is always unity. The dotted curves, however, give the variations of R plotted against the time of ***emission***, and it is the variation *as heard* that is required. It will be seen from Fig. 1 that the unit value of R emitted at C is not heard until the

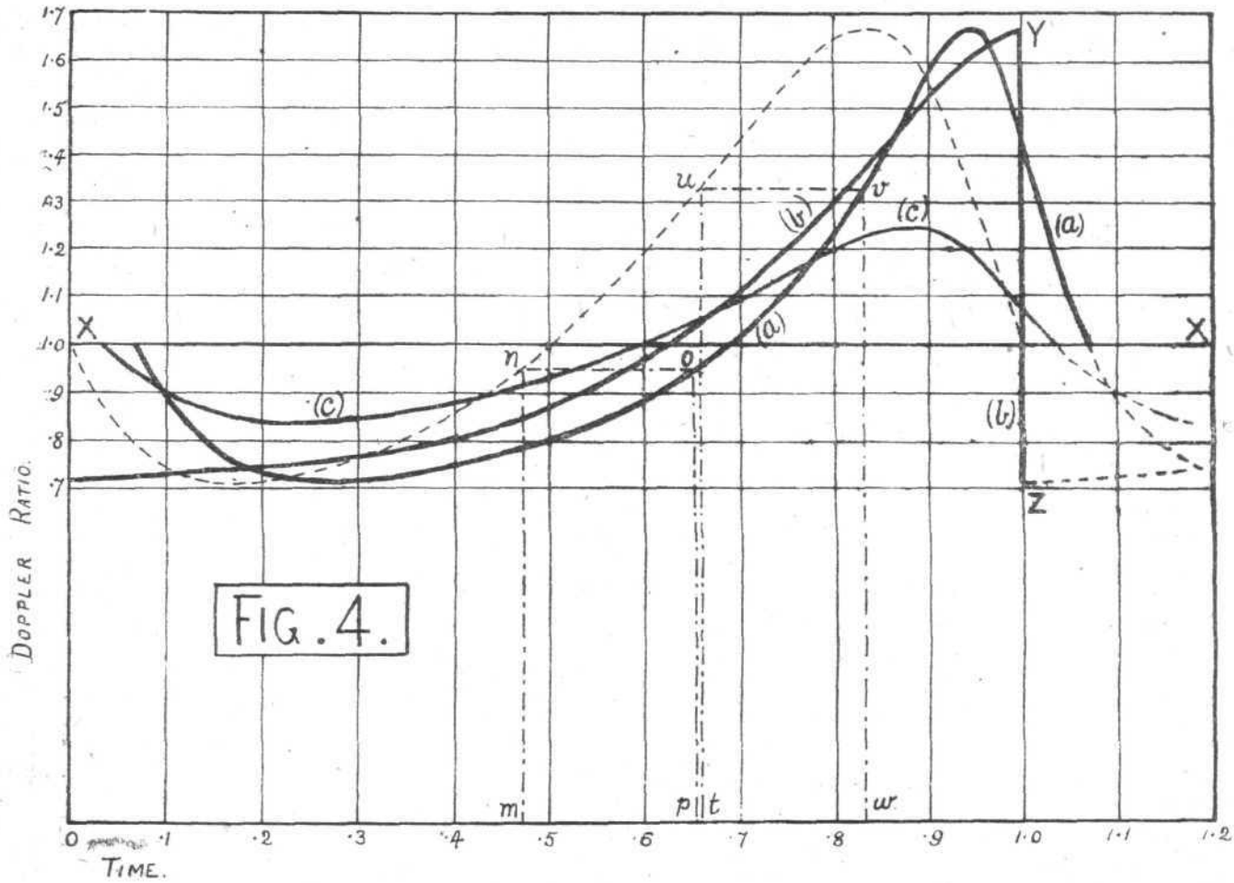


FIG. 4.

lapse of a period depending upon the value of h, and that for other points along the path the time-lag, or period elapsing before the value of R proper to each point is heard, increases the further the point is from C. Accordingly, the ordinates of the dotted curves require displacement to the right, the displacement of each being proportional to the time lag. As a result we get the full-line curves which are slightly steeper than the dotted curves above the line xx, and not quite so steep below. With $h = o$, the sudden drop would be heard immediately it occurs. With $h = 100$, the unit value of R is heard $\frac{1}{11}$ second later, and with $h = 1{,}000$, $\frac{10}{11}$ second later, the source being then 40 ft. and 400 ft. past the pedal point. The full curves give a graphic representation of the manner in which the note heard falls, and show clearly that the further the pedal point is away from the observer, the more gradual is the fall of the note. It is of interest to notice, also, that the full-line curves intersect at a common point on the zero time ordinate. This indicates that the value of R for the impulse which reaches the observer at the instant the source is actually at the pedal point, an impulse really emitted some time previously, is always the same, no matter what the distance of the pedal point. Referring to Fig. 1, let E be a point such that the impulse emitted there reaches the observer at the instant the source reaches C. Then we have $\frac{s}{v} = \frac{r}{V}$ or $\frac{s}{r} = \frac{v}{V}$. Substituting this value for $\frac{s}{r}$ in the expression $R = \frac{V}{V - v\frac{s}{r}}$ we get $R = \frac{V^2}{V^2 - v^2}$, which is independent of h. With $v = 440$ we get $R = 1.19$, the value of R for all the full-line curves where these intersect one another and BD. Since

$$\frac{V^2}{V^2 - v^2} = \left(\frac{V}{V + v}\right)\left(\frac{V}{V - v}\right)$$

we see that this value of R is the product of the maximum and minimum values of R, *i.e.*, $\frac{5}{3} \times \frac{5}{7} = \frac{25}{21} = 1.19$.

We can now examine the variations in R when the source moves uniformly round a circular path, say in anti-clockwise direction. Fig, 3, the observer being at O exterior to, but in the same plane as, the circle. At the point P, $\phi = 90°$ so that $R = 1$. As the source moves round the circle, ϕ decreases until the point Q, where the tangent from o touches the circle, is reached, when $\phi = 0$ and R has its lowest possible value $\frac{V}{V + v}$. As the motion continues ϕ increases, again becoming 90° at T and then obtuse, as at V. The increase continues until the point of contact Y of the tangent OY is reached, when $\phi = 180°$ and R has its maximum value $\frac{V}{V - v}$, after which ϕ decreases. It will be noticed that at the points Q, Y respectively, the source is moving directly away from, and directly towards, the observer. We thus see that R decreases along YPQ and increases along QTY and also (since ϕ is acute along PQT and obtuse along TYP) that R is less than unity during the first half of the movement and more than unity during the second half. The value of R at any point of the path can be calculated from the expression $R = \frac{V}{V + v \cos \phi}$. This has been done and the results plotted, giving the curves shown in Fig. 4. In calculating these curves the following values have been used, viz. :—$V = 1{,}100$ ft. per sec., $v = 440$ ft. per sec., radius PW = 1,000 ft. and $OP = PW$. The period in which the source moves once round the circle has been taken as the unit of time in plotting. With the above dimensions the angle QWY is 120°, so that the period during which R falls is half the period during which R rises. The dotted curve, Fig. 4, shows R plotted against time of emission. The full-line curve (a) shows R plotted against time of reception, the curve being obtained by displacing each ordinate of the dotted curve towards the right an amount corresponding to the time lag due to the lengths of the corresponding paths, such as PO, QO, between source and observer. As the distance of the observer from the centre of the circle is increased, the points Q, Y move further apart towards the extremities of the diameter of the circle at right angles to WO. The periods of rise and fall in the value of R thus become more nearly equal. Also, the time lag becomes greater but more uniform, and therefore produces greater displacement but less distortion in the curve. On the other hand, as the distance of the observer decreases, the points Q, Y come nearer to the point P, so that the period of fall becomes shorter and of rise longer. When the observer is on the circumference of the circle, the points O, P, Q, Y, coincide. The fall in the value of R therefore takes place suddenly, whilst there is a continuous rise as the source travels round the circle from the observer and back again. ϕ increases continuously from zero to 180° as the source moves round the circle, and then, as the source passes through P, falls suddenly from 180° to zero. If we put θ for the angle such as SWP swept out from WP by the line SW, joining the source and the centre of the circle, as the source is always moving at right angles to SW and the line PS joining the observer to the source is always at right angles to the bisector of the angle θ, it follows that $\phi = \frac{\theta}{2}$ for all positions of the source. The distance of the observer from the source is the diameter of the circle multiplied by $\sin \frac{\theta}{2}$, and this distance divided by the velocity of sound gives the corresponding time-lag. The curve (b) gives the variations in R as heard by an observer at P, the sudden fall being shown by the vertical line YZ, Fig. 4. When the observer is inside the circle the maximum and minimum values of ϕ are found at the points where the circle is intersected by a line through the observer at right angles to the line joining the observer to the centre of the circle. With the observer at O', the middle point of PW, these points coincide with the points Y, Q at which the maximum and minimum values occur with the observer at O. The maximum and minimum values of ϕ are always supplementary, and the minimum value is always equal to the corresponding value of θ. Thus with the dimensions already given with respect to Fig. 3 $\theta = QWP = 60°$ so that ϕ varies between 60° and 120°, and the maximum and minimum values of R are respectively $\frac{1{,}100}{1{,}100 - 220} = 1.25$ and $\frac{1{,}100}{1{,}100 + 220} = .83$. The curve ($c$) shows the variations of R plotted against time of reception, the observer being at O'. As the observer is placed nearer and nearer to the circumference the maximum and minimum values of ϕ become more nearly equal to 180° and zero respectively. On the other hand, as the observer approaches the centre of the circle the maximum and minimum values of ϕ approximate to 90°. With the observer at the centre, $\phi = 90°$ and is constant, that is to say the note emitted is heard with its true frequency.

When the variations in R are plotted against both time of emission and reception on the same diagram, we may use the diagram as follows. Assume it is required to find the varying values of R for a note emitted between any two points of the path, of the source, such as those corresponding to the points m, t, Fig. 4. Draw the dotted curve ordinates mn, tu; through n, u draw the horizontals no, uv, meeting the curve (a) at o, v; and draw the ordinates op, vw. Then mp gives the time lag of the initial impulse and tw the time lag of the final impulse. Thus the note emitted during the time mt is heard during the time pw. The ratio of the average frequency of the note heard to the average frequency of the note emitted is therefore $\frac{mt}{pw}$, and this is equal to the average value of R for the note under consideration. $\frac{mt}{pw}$ is equal to the average height of the figure $povw$, so that by obtaining mt and pw, estimation of the average height is avoided. When ov is short or nearly straight, however, the height of the middle point of ov may be taken as the average height. We have seen that with given values of V and v the value of R depends on ϕ. When ϕ is constant the note heard is of constant pitch, not necessarily the pitch of the note emitted. In general, for ϕ to be constant when the source describes a path in the plane of the observer, it is of theoretical interest to note that the path is an equiangular or logarithmic spiral. From this point of view the circular path with the observer at the centre is a particular form of the spiral in which $\phi = 90°$, and the straight line path passing through the observer a particular form of the spiral when $\phi = o$ or 180°.

In conclusion, it should be borne in mind when comparing theoretical results with observed phenomena that the untrained ear is liable to confusion between the varying intensity of the note due to proximity or remoteness of the source, and the variation of pitch. Moreover, in the case of an aeroplane as the source, the sound heard is not a simple note but contains a multiplicity of noises due to vibration of various parts of the machine, rotation of propeller, and engine exhaust, and these sound components are seldom constant for more than comparatively short intervals.

* * * *

End of the Bristol Strike.

BRISTOL aeroplane workers, to the number of between 2,000 and 3,000, came out on strike on December 13th for an increase in wages. As a result of negotiations with the Ministry of Munitions, the men returned to work on December 17th, pending a further conference with the Ministry.

FLIGHT
& AIRCRAFT ENGINEER

INTERNATIONAL AIRCRAFT STANDARDS.

(*Concluded from page* 1317.)

3S12—*Specifications for High-Strength Steel Wire.*

GENERAL.—1. The general specifications, 1G1, shall form, according to their applicability, a part of these specifications.

MATERIAL.—2. The wire shall be manufactured of either I.A.S.B. standard steel No. 1065, No. 1070, or No. 1080, the compositions of which are listed below.

MANUFACTURE.—3. The steel used shall be manufactured by the acid open-hearth process. Every reasonable precaution shall be taken to keep different heats carefully separated and identified throughout the rolling and drawing of the wire and to the final stage of inspection and shipment.

(*b*) It shall be uniformly coated with pure tin, to solder readily.

WORKMANSHIP AND FINISH.—4. The wire shall be cylindrical and smooth and may show no evidence of scrapes, splints, cold shuts, rough tinning. or other defects not in accordance with best commercial practice.

PHYSICAL PROPERTIES AND TESTS.—*Tensile Test.*—5. (*a*) Samples for the tensile test shall not be less than 15 ins. (381 mm.) long and free from bends and kinks. In making tensile tests on aircraft wire, the distance between jaws of testing machine, with the sample in place and before test, shall be 10 ins. (254 mm.). The wire must not break at less than the amount specified in the attached table, which is a part of this specification.

Torsion Test.—(*b*) Samples for the torsion test shall be straight and not less than 10 ins. (254 mm.) long. The sample shall be gripped by two vices 8 ins. (203.2 mm.) apart; one vice shall be turned uniformly at a speed not exceeding 60 revolutions per minute (on the larger sizes of wire this speed shall be reduced sufficiently to avoid undue heating of the wire). One vice shall have free axial movement in either direction. All wire shall be required to withstand the minimum number of complete turns shown in the attached table, and which are calculated from the relation :

$$\text{Number of turns} = \frac{2.7}{\text{diameter in inches}} = \frac{68.6}{\text{diameter in millimetres.}}$$

Bend Test.—(*c*) Samples for bend test shall be straight and not less than 10 ins. (254 mm.) long. One end of the sample shall be clamped between jaws having their upper edges rounded with 3/16 (0.188) in. (4.76 mm.) radius. The free end of the wire shall be held loosely between two guides and bent 90 deg. over one jaw ; this is to be counted as one bend. On raising to a vertical position the count will be two bends. Wire shall then be bent to the other side, and so forth, alternating to fracture. The minimum number of bends required is stated in the attached table.

Wrapping Test.—(*d*) A wrapping test is to be made on at least 10 per cent. of the total number of coils offered for inspection at one time. The wire is wrapped around its own diameter eight consecutive turns with a pitch substantially equal to the diameter of the wire and then unwrapped, maintaining the free end at approximately 90 deg. with the mandrel. It must stand this test without fracture. Because of the possibility of personal error in making this test, failure on one test is not considered conclusive, and if required to do so the inspector shall make at least one, but no more than two, additional tests on the sample of wire. If any of these tests are successful, the material shall be passed as satisfactory in this respect.

SELECTION OF TEST SPECIMEN.—6. A tensile, a torsion, and a bend test shall be made on each end of each piece of coil or wire. When an individual coil of wire is to be divided into smaller coils to meet special requirements, it is sufficient to make one test on the original coil and to cut and seal the small coils in the presence of the inspector.

DIMENSIONS AND TOLERANCES.—7. (*a*) All wire for this purpose shall be furnished in decimal sizes corresponding to the American Wire Gauge (Brown and Sharpe gauge).

(*b*) A permissible variation of 0.002 in. (0.051 mm.) above gauge on all sizes will be accepted, but no wire will be accepted having a variation of more than 0.0005 in. (0.013 mm.) below gauge.

DELIVERY, PACKING AND SHIPPING.—8. (*a*) Wire covered by this specification shall be shipped in coils or bundles wrapped closely with a layer of plain strong paper in strips no less than 3 ins. (76.2 mm.) wide and then covered with another wrapping of waterproof paper of an approved quality.

(*b*) The size and weight of packages or coil shall conform to the following unless otherwise specified on orders : 0.072 in. (1.828 mm.) and larger, mean diameter of coils 22 ins. (559 mm.), minimum weight of coil 25 lbs. (11.34 kg.) ; 0.064 in. (1.628 mm.) and smaller, mean diameter of coils 12 ins. (305 mm.), minimum weight of coil 10 lbs. (4.54 kg.).

Table of Physical Properties, Weights, and Sizes.

ENGLISH UNITS.

American Wire Gauge.	Diameter in inches	Minimum torsion in 8 ins.	Weight in pounds per 100 ft.	Number of bends through 90 deg.	Breaking strength, minimum lbs.	Tensile strength in pounds per sq. in.
6	0.162	16	7.01	5	4,500	219,000
7	0.144	19	5.56	6	3,700	229,000
8	0.129	21	4.40	8	3,000	233,000
9	0.114	23	3.50	9	2,500	244,000
10	0.102	26	2.77	11	2,000	244,000
11	0.091	30	2.20	14	1,620	254,000
12	0.081	33	1.744	17	1,300	252,000
13	0.072	37	2.383	21	1,040	255,000
14	0.064	42	1.097	26	830	258,000
15	0.057	47	0.870	29	660	259,000
16	0.051	53	0.690	34	540	264,000
17	0.045	60	0.547	42	425	267,000
18	0.040	67	0.434	52	340	270,000
19	0.036	75	0.344	70	280	275,000
20	0.032	85	0.273	85	225	280,000
21	0.028	96	0.216	105	175	284,000

METRIC UNITS.

American Wire Gauge.	Diameter in millimetres.	Minimum torsion in 203.2 mm.	Weight in kilograms per 100 m.	Number of bends through 90 deg.	Breaking strength, minimum kilograms.	Tensile strength, in kilograms per square millimetre.
6	4.115	16	10.44	5	2,041	954.0
7	3.665	19	8.28	6	1,678	161.1
8	3.264	21	6.55	8	1,361	163.8
9	2.906	23	5.21	9	1,134	171.6
10	2.588	26	4.12	11	907	171.6
11	2.305	30	3.28	14	735	178.6
12	2.053	33	2.597	17	590	177.2
13	1.828	37	2.060	21	472	179.4
14	1.628	42	1.635	26	376.5	181.5
15	1.450	47	1.295	29	297.6	182.1
16	1.291	53	1.028	34	244.9	185.6
17	1.150	60	0.814	42	192.8	187.7
18	1.024	67	0.646	52	152.4	189.8
19	0.9116	75	0.512	70	127.0	193.4
20	0.8118	85	0.406	85	102.1	196.8
21	0.7230	96	0.322	105	79.4	199.6

INSPECTION AND REJECTION.—9. A tag supplied by the manufacturer and filled in by the Government inspector with ink, showing the number of the test as per his official list of tests, the diameter of the wire, the breaking strength, and torsion and bend tests, shall be attached to each coil or piece of wire accepted by him or by the salvage board. Such tag shall be sealed on the bundle with a steel wire of approved design and a lead seal bearing the private mark of the inspector doing the work.

Chemical composition of standard carbon steels.

No.	Carbon.	Manganese.	Phosphorus, maximum.	Sulphur, maximum.
1065	0.60–0.70	0.50–0.70	0.040	0.045
1070	0.65–0.75	0.50–0.70	0.040	0.045
1080	0.75–0.90	0.25–0.50	0.040	0.045

2N2—*Specifications for Ingot Copper.*

GENERAL.—1. The general specifications, 1G1, shall form according to their applicability, a part of these specifications.

MATERIAL.—2. (*a*) Copper may be either lake copper originating on the northern peninsula of Michigan, U.S.A., or it may be electrically refined copper.

Analysis.—(*b*) The copper in all shapes shall have a purity of at least 99.880 per cent., as determined by electrolytic assay, silver being counted as copper.

Sampling.—(*c*) One bar, cake, billet, ingot, or slab shall be taken for analysis from each lot of 5,000 lbs. (2,268 kg.) or less, but not more than 10 bars, cakes, billets, ingots, or slabs need be taken from a carload.

IDENTIFICATION AND MARKING.—3. All wire bars, cakes, slabs, and billets shall be stamped with the maker's brand and furnace charge mark. Ingot and ingot bars shall have a brand stamped or cast in, but need have no furnace charge mark.

DELIVERY, PACKING AND SHIPPING.—4. The refiner shall arrange carloads or lots so that as far as possible each shall contain pieces from but one furnace charge, in order to facilitate testing by the user.

References : A.S.T.M. Specifications B5—13.

2N3—*Specifications for Spelter.*

GENERAL.—The general specifications, 1G1, shall form, according to their applicability, a part of these specifications.

MATERIAL.—2. (*a*) Under these specifications virgin spelter —that is, spelter made from ore or similar raw material by a

process of reduction and distillation or by electrolysis and not produced from reworked metal—is recognised in five grades, as follows :

A	High Grade.
B	Intermediate.
C	Brass Special.
D	Selected.
E	Prime Western.

Composition.—(*b*)

A. High Grade.—The spelter shall not contain over :

	Per cent.
Lead	0.07
Iron	0.03
Cadmium	0.07

It shall be free from aluminium. The sum of the lead, iron, and cadmium shall not exceed 0.10 per cent.

B. Intermediate.—The spelter shall not contain over :

	Per cent.
Lead	0.20
Iron	0.05
Cadmium	0.50

It shall be free from aluminium. The sum of the lead, iron and cadmium shall not exceed 0.50 per cent.

C. Brass Special.—The spelter shall not contain over :

	Per cent.
Lead	0.60
Iron	0.03
Cadmium	0.50

It shall be free from aluminium. The sum of the lead, iron and cadmium shall not exceed 1 per cent,

D. Selected.—The spelter shall not contain over :

	Per cent.
Lead	0.80
Iron	0.04
Cadmium	0.75

It shall be free from aluminium. The sum of lead, iron, and cadmium shall not exceed 1.25 per cent.

E. Prime Western.—The spelter shall not contain over :

	Per cent.
Lead	1.60
Iron	0.08

Sampling.—(*c*) One slab shall be taken for analysis from each lot of 5,000 lbs. (2,268 kg.) or less, but not more than 10 slabs need be taken from a carload. Saw each slab completely across from the middle of one long side to the middle of the other and use the sawdust as the sample ; or drill three 9-mm. holes along one diagonal of each slab, boring completely through and taking care to make fine drilling ; the holes should be drilled as nearly as possible at the middle and halfway between either end and the middle of such diagonals. Go over the drillings or sawings with a powerful magnet to take out any iron which may have come from the drill or saw, and mix the sample thoroughly. The drill or saw must be thoroughly cleaned before use, and no lubricant shall be used in either drilling or sawing.

IDENTIFICATION AND MARKINGS.—3. A brand shall be cast in each slab by which the maker and grade can be identified.

References : A.S.T.M. Specifications B6—14 revised.

3N2—Specifications for Manganese Bronze Castings.

GENERAL.—1. The general specifications, 1G1, shall form, according to their applicability, a part of these specifications.

MATERIAL.—2. The chemical composition shall be as follows: Copper, 56 to 60 per cent. ; zinc, 37 to 41 per cent. ; hardening constituents (which may include tin, iron, manganese, and aluminium), 3 per cent. maximum ; lead, 0.15 per cent. maximum.

MANUFACTURE.—3. (*a*) The material must be made from lake or electrolytic copper according to the I.A.S.B. specification 2N2 and virgin spelter of A or B grade according to I.A.S.B. specification 2N3.

(*b*) No scrap shall be used, except such as may accumulate in the manufacturer's plants from material of the same composition and of their own make.

WORKMANSHIP AND FINISH.—4. Castings must be homogeneous and free from shrinkage cracks, spongy spots, blowholes, and foreign matter. Any castings developing defects in machining must be replaced by the manufacturer. The full weight of material in the original casting must be returned by the purchaser for each replacement.

PHYSICAL PROPERTIES AND TESTS.—5. Manganese bronze castings shall have the following physical properties : Minimum tensile strength, 70,000 lbs. per sq. in. (49.21 kg./mm.^{2}) ; minimum yield point, 30,000 lbs. per sq. in. (21.09 kg./mm.^{2}) ; minimum elongation, 15 per cent. in 2 ins. (50.8 mm.).

SELECTION OF TEST SPECIMEN.—6. (*a*) The test bars shall be cast either on the casting, if the size will permit, or on the bottom of a 3-in. square test block sufficiently long to accommodate the test bar. Chills shall not be allowed in casting the test bar.

(*b*) The test bars and casting shall have the heat number cast or stamped on the pieces.

(*c*) At least two test bars shall be cast from each heat.

(*d*) One test shall be made to represent each heat, but in case of a flaw in the test bar or a break outside of the middle third of the gauge length, further tests may be made on extra test pieces, as provided for in the foregoing paragraph.

DIMENSIONS AND TOLERANCES.—7. All castings must be true to pattern with correctly placed cores.

3N4—Specifications for Naval Brass or Equivalent Alloy Bars.

GENERAL.—1. The general specifications, 1G1, shall form, according to their applicability, a part of these specifications.

USE.—2. The material required under this specification is intended primarily for airplane turnbukle barrels.

MATERIAL.—3. The chemical composition shall be as follows :

	Per cent.
Copper	59 to 63.
Tin	0.5 to 1.5
Iron, maximum	0.10
Lead, maximum	0.3
Zinc	Remainder.

MANUFACTURE.—4. (*a*) The material must be made from lake or electrolytic copper according to the I.A.S.B. specifications 2N2, and virgin spelter of A or B grade according to the I.A.S.B. specification 2N3.

(*b*) No scrap shall be used, except such as may accumulate at the manufacturer's plants from materials of the same composition and of their own make.

WORKMANSHIP AND FINISH.—5. All bars are to be sound, straight, free from roaks, laps, cracks, twists, seams, and damaged ends, and are to have a workmanlike finish.

PHYSICAL PROPERTIES AND TESTS : *Tensile Test.*—6. (*a*) Rods from $\frac{1}{4}$ in. (6.35 mm.) to 1 in. (25.4 mm.) inclusive, shall have—

	Pounds per square inch.	Kilograms per square millimetre.	Per cent.
Minimum tensile strength	67,000	47.10	..
Minimum yield point	45,000	31.64	..
Elongation in 2 ins. (50.8 mm.)	..	..	22
Reduction of area	..	..	45

Bending Test.—(*b*) The rods shall stand being bent, cold, through an angle of 180 deg. and to a radius equal to the diameter of the rod without fracture.

Strain Test.—(*c*) The rod shall stand an immersion in an aqueous solution containing 100 grams of mercurous nitrate and 13 cu. cm. of 1.42 specific gravity nitric acid per liter for 15 minutes without cracking.

SECTION OF TEST SPECIMENS.—7. (*a*) Bars shall be grouped into lots of not more than 50. Three test pieces, one for each of the above tests, will be cut from a bar selected by the inspector from each lot or fraction thereof.

(*b*) The bending-test bar will be full size.

(*c*) The strain-test bar will be at least 12 ins. (304.8 mm.) long, of full size, and shall be taken without bending, springing polishing, or any other preparation whatever. At least 9 ins. (228.6 mm.) of the length of this bar shall be immersed in the solution.

DIMENSIONS AND TOLERANCES.—8. Rods shall not vary in diameter more than the following amounts : Up to and including $\frac{3}{8}$ in. (9.53 mm.), plus or minus 0.0015 in. (0.038 mm.); from $\frac{3}{8}$ in. (9.53 mm.) to and including 1 in. (25.4 mm.), plus or minus 0.0030 in. (0.0076 mm.).

DELIVERY, PACKING AND SHIPPING.—9. (*a*) Rods and bars when ordered to any length will be furnished in stock lengths, unless it is specifically required that lengths be exact.

(*b*) Stock lengths will be as follows : When ordered in 12-ft. (3.66 m.) lengths, no lengths less than 8 ft. (2.44 m.) ; when ordered in 10-ft. (3.05 m.) lengths, no lengths less than 8 ft. (2.44 m.) ; when ordered in 8-ft (2.44 m.) lengths, no lengths less than 6 ft. (1.83 m.) ; when ordered in 6-ft. (1.83 m.) lengths, no lengths less than 4 ft (1.22 m.).

(*c*) When ordered to the lengths given above, the weight of lengths less than length ordered shall not exceed 40 per cent. of any one shipment.

(To be continued.)

To Readers—One and All.

THE Editor of "FLIGHT" will at all times be pleased to consider original articles (illustrated or otherwise) on subjects directly or indirectly allied with aviation. All articles accepted will be paid for ; a high literary standard of writing is not essential ; it is the facts which matter. Practical explanatory articles are most acceptable. Diagrams and similar illustrations need only be rough sketches, if necessary.

FLIGHT

THE PRINCIPLES OF RANGE-FINDERS AND BOMB-SIGHTS FOR AIRCRAFT.

By C. LEVICK.

THE "Goerz" range-finder described in "FLIGHT" of September 13th opens up an immense field for these and similar apparatus, the general elementary principles of which it is proposed to ventilate. Their use, of course, is to find the exact moment, or rather position, at which a bomb must be released to hit any desired target. It is well known that bombs must be fired before the machine is perpendicularly over the target, but it is not so clear that the exact position depends *only* upon the height above the target, and the velocity of the bomb, *i.e.*, the velocity of the machine relative to the ground—this assumption, of course, excludes effects of wind, air resistance, and many other minor conditions, some of which are exceedingly difficult, if not impossible, to deal with, and are therefore, for the purposes of this paper, ignored.

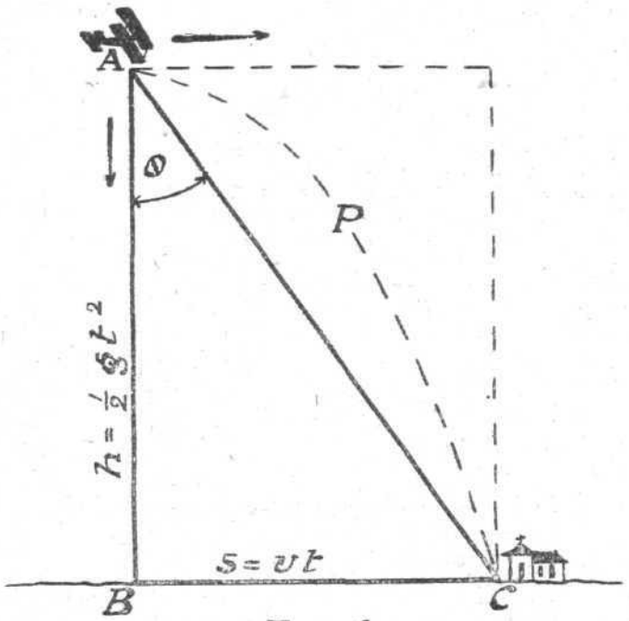


FIG. 1.

Suppose in Fig. 1 an aeroplane at A wishes to drop bombs on a building at C, also that it is travelling at v miles per hour, and at h feet above target. From elementary mechanical principles, and Newton's Laws, the bomb when released at A will move along a parabolic curve, $A\ P\ C$, and the time t seconds taken to fall through h feet will equal the time taken to travel s feet—the horizontal distance the machine is from the target C. Now if A is the correct point for release, we can find from the above particulars, the angle $\theta°$, which will enable us evenually to know exactly when to drop the bomb.

For—

$$\tan\theta = \frac{s}{h} = \frac{vt}{\frac{1}{2}gt^2} = \frac{2v}{gt}$$

$$\therefore \theta = \tan^{-1}\left(\frac{2v}{gt}\right)$$

But $h = \frac{1}{2}gt^2 \quad \therefore t^2 = \left(\frac{2h}{g}\right)$

and $t = \sqrt{\frac{2h}{g}}$

And substituting—

$$\theta = \tan^{-1}\left(\frac{2v}{g\sqrt{\frac{2h}{g}}}\right)$$

If v is in miles per hour and g taken as 32.2 f.s.s.—

$$\theta = \tan^{-1}\left(\frac{\frac{2\times 88}{60}v}{32.2\sqrt{\frac{2h}{32.2}}}\right)$$

$$\theta = \tan^{-1}\left(0.366\frac{v}{\sqrt{h}}\right) \qquad (a)$$

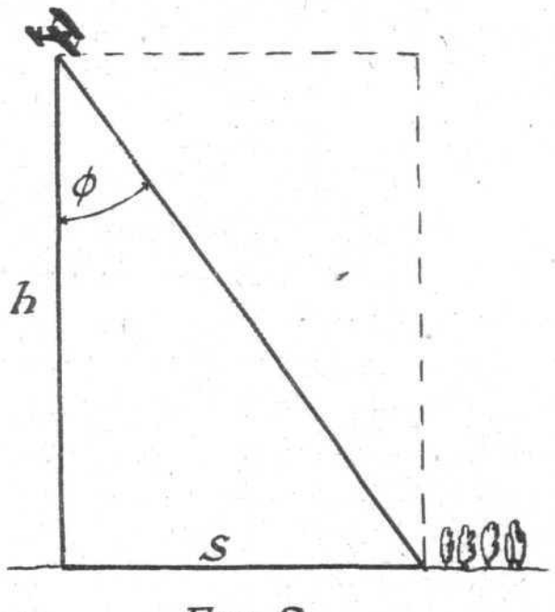


FIG. 2.

This equation contains only two unknowns, v and h, hence the point A is known when the height and velocity of machine are known; the sighting apparatus is set beforehand to the angle θ, which causes the target to appear in sights when machine is at A.

In actual practice, the values of h and v are subject to considerable variations, and are not easy to find. The aneroid barometer, at present, has to be relied upon for h, the height of target above sea level being deducted from height of machine above sea level read. In a deliberately planned raid, this is a simple matter with a good contour map. The value of v is much more difficult to find, owing chiefly to effects of the wind, which not only reduces or increases speed of aeroplane, but continues to act on bomb when falling, causing it to deviate from the theoretical—and easily calculated—path. The method used on the "Gothas" with the "Goerz sighter" is ingenious, and deserves much attention and many practical trials. It is explained below.

To obtain the actual velocity of aeroplane relative to the earth, sight an object in line of flight through sight tube and

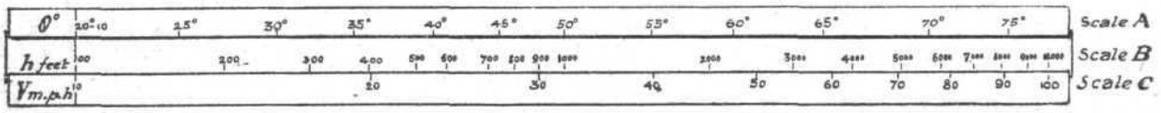


Fig. 3.

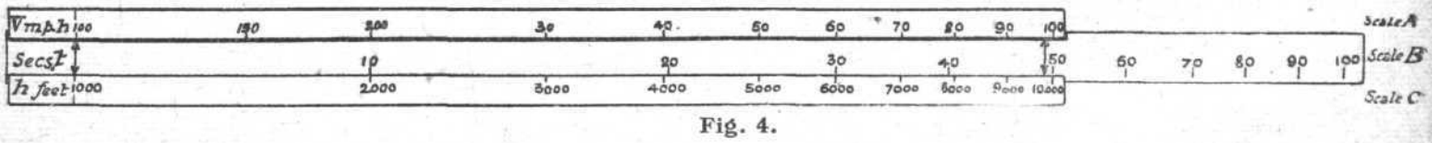


Fig. 4.

time it from the moment when sighted to the moment when vertically underneath, measuring the angle turned through by the tube. In Fig. 2, let

h = height of machine in feet.
s = horizontal distance between machine and object in feet.
ϕ = angle in degrees which tube turns through.
v = velocity of machine relative to earth in m.p.h.
t = time taken in seconds.

Then $$v = \frac{s}{t} \times \frac{60}{88}$$

But $$s = h \tan \phi.$$

$$\therefore v = \frac{60}{88} \times \frac{h \tan \phi}{t}$$

$$= 0.682 \cdot \frac{h \tan \phi}{t}$$

If a standard angle of 36° 10′ were always taken for ϕ, we have :—

$$v = 0.682 \times \frac{h \times 0.734}{t}$$

$$\therefore v = \frac{h}{2t} \qquad (b)$$

The difficulty of filling in and working out the values of equations (*a*) and (*b*) with different sets of values, can be got rid of either by using a graph, a table, or a slide rule. It is not difficult to arrange a slide rule on which the unknowns can be read instantly with one setting. The latter method has the advantage—if its use is practicable when flying—that *any* combination of the unknowns can be solved instantly !

The principle of a suitable ruler is the same as that of the standard Mannheim type. The scales are arranged as in Figs. 3 and 4 on the front and back face respectively.

Front face for solving $\theta = \tan^{-1}\left(0.366 \frac{v}{\sqrt{h}}\right)$.

Scale *A* on bottom edge of top strip of ruler is a scale of degrees.

Scale *B* on bottom edge of middle strip of ruler—the slide—is a scale of heights in feet.

Scale *C* on top edge of bottom strip of ruler is a scale of velocities in m.p.h.

To work ruler, suppose for example :—

v = 90 m.p.h. and h = 2,000 feet.

Then $\theta = \tan^{-1}\left(.366 \frac{v}{\sqrt{h}}\right) = \tan^{-1}\left(.366 \frac{90}{\sqrt{2000}}\right)$.

To *v*, *i.e.* 90 on scale *C*, set *h*, *i.e.* 2,000 on scale *B*, and read θ° over index on scale *A*. $\theta = 36\frac{1}{2}$° approx.

The method of calibrating the rule is as follows. Scale *B* is half the length of *C*, and therefore the heights, although marked as *h* feet, represent actually $\sqrt{h}$ feet. The first operation therefore divides *v* by $\sqrt{h}$. The multiplication of this fraction by factor .366 is done by placing scale *A*—before being marked into degrees—.366 units to the left.

Back face, for solving $\phi = \frac{h}{2t}$.

Scale *A* on bottom edge of top strip of ruler is a scale of velocities in m.p.h.

Scale *B* on bottom edge of middle strip of ruler—slide—is a scale of seconds.

Scale *C* on top edge of bottom strip of ruler is a scale of height *h* in feet.

To work ruler, suppose for example :—

h = 5,100 feet and t = 30 secs.

Set 30 on *B* to 5,100 on *C* and over index on *A* read 85 m.p.h.

The calibrating is executed by making all scales the same length, thus the value of $\frac{h}{t}$ in the equation $v = \frac{h}{2t}$ is given under 10 on scale *B* and also scale *A*. Division by 2 is made by placing indices .3010 units (of the slide) to left before being marked with numerals. A very suitable unit for the scales is 2 cms. ; this brings the total length to about 8 inches, a very convenient size.

Description of the actual sighting and dropping apparatus has been so far purposely avoided, as it is hoped that the reader has for himself, by this time, got a fair idea of their nature and functions.

No special dropping mechanism is required, but it is essential that the axes of the bombs are perpendicular to the normal flying axis of the aircraft, and immediately under the pivot of the sighting tube.

To ensure that the machine is flying in the plane of its normal flying axis, the pilot must be provided with a serviceable spirit level, placed horizontally with this plane.

The sighting apparatus must be in the nature of a telescope, capable of being rotated clockwise through 90°, *i.e.*, from horizontal to vertical position. The angle of the line of sight to the vertical—angles θ and ϕ—must be indicated on a dial or graduated ring. An alternative arrangement is the rotating prism and universally jointed sighting tube, of the " Goerz Range Finder."

For calculating the value of *v* it is obvious that a stop watch synchronised with the turning motion of the standard angle—suggested 36° 10′—would be an advantage ; otherwise it would be necessary to time the angular rotation by hand. In any case, timing mechanism must be included to complete the whole apparatus.

Here is another opportune moment to point out the field for an ingenious instrument maker. If, for instance, it were possible to read the angles θ and ϕ and the time *t* secs. without removing the eye from the eyepiece, it would save time and increase the accuracy of the results.

Application.—Having described generally the main details, it will be as well to follow through with the exact procedure on a deliberately planned raid. As a precaution beforehand, the state of the atmosphere is taken and approximate height of flight decided upon. From a contour map the height above sea level of objective is taken, which will be deducted from height read on aneroid some time before reaching target, thus giving value of *h*. The next thing to do is to calculate the value of *v*, to do which the pilot will first steady the machine as much as possible, keeping it flying straight ahead and in its natural flying plane. The observer will next sight a distant object in front, and keep it in view until perpendicularly under machine, recording time in seconds taken, and angle sight tube has turned through ; from these values *v* is calculated by equation *b*. With this value of *v* angle of release θ° is calculated by equation *a*, and sighting tube adjusted to it and locked.

The machine will now be approaching target, which will—providing that a straight course has been kept—appear in sighting tube. This is the moment for releasing the bomb. In the " Goerz Sighter " this right and left or third motion of direction, is corrected by universally jointing the range finder, and making the rotation caused by machine turning to right or left be indicated to the pilot by a sensitive electro-galvanometer. It is very obvious that, before it can be said how useful these apparatus will be to aviation as a science, many practical experiments must be carried out, and this together with the perfecting of the instruments and the finding out of the necessary corrections for wind and drift, are problems left to the practical man.

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German Bomb Factory Destroyed.

ACCORDING to the *Svenska Dagbladet*, a big ammunition factory, which mainly manufactured bombs for the use of Zeppelins and aeroplanes, has been blown up near Kiel. All the factory buildings, as well as the railway station, close to which they stood, are said to have been burnt to the ground and the railway line destroyed to a length of several hundred yards. A number of people were killed.

An Explosion at Friedrichshafen.

A MESSAGE from Zurich states that an explosion occurred on December 14th at the Zeppelin works at Friedrichshafen, as the result of an accumulation of gas becoming ignited. A number of persons were injured.

Poisonous Soup from Raiders.

A MESSAGE from the *Daily Mail* correspondent in Paris states that during the last air raid on Calais the Germans dropped not only 100 bombs but also a number of small packets bearing an inscription in English to the effect that they contained soup powder. Directions were given to dissolve the powder in cold water and then to add a pint of boiling liquid. Analysis has shown that the packets contain an extremely violent poison, and the *Temps* states that all the families who took the soup have died. In Eastern France a number of children have been killed by poisoned sweets and explosive pencil-cases dropped from aeroplanes.

Demand for Aeroplane Workers.

DURING the hearing of a case before the Russian Tribunal, at Caxton Hall, on December 11th, Sir Edward Smith, who presided, referred to the big demand for skilled workers in aircraft factories. He knew that in one factory, which now employed 2,000 men, it was proposed to increase the number to 5,000 in the next six months.

FLIGHT

FORESIGHT.—TWENTY-FOUR YEARS AGO.

A GOOD many with the flimsiest justification are so anxious to announce what they prophesied in the days that have gone, that the following forecast of aerial warfare, by Colonel (then Major) J. D. Fullerton, R.E., contributed to the "Operations of the Division of Military Engineering," Chicago Exposition, 1893—note the year—will be found more than usually interesting.

SOME REMARKS ON AERIAL WARFARE.

By Major J. D. FULLERTON, R.E.

1. *Aerial Warfare now Possible.*—Recent investigations in aeronautical science seem to point to the fact that in the near future a new and hitherto untried branch of the art of war will have to be taken into consideration by the combatants in future campaigns.

A large navigable balloon has sailed through the air with fair success, improved ones are in progress, and some of the ablest engineers in the world are now at work at flying machines, which give every reasonable promise of solving the long-tried-for problem—the problem of aerial flight. It should be especially noticed that the recent experiments and investigations have been carried out with a skill and care hitherto unknown in aeronautical science and that it is only of comparatively late years that the resources of science have been such as to enable these experiments, most of which require exceedingly delicate and accurate recording instruments, to be carried out.

2. *Desirable to examine the Effect on the Art of War.*—It seems desirable to examine the probable effect of a satisfactory solution of the problem of flight on the art of war, because recent history shows that every new discovery likely to increase the power of nations is eagerly adopted by the navies and armies of the present day. Steam has revolutionised naval warfare, the telegraph has considerably altered war by land, and there can be no doubt that successful airships will in the future cause as great a revolution in the art of war as the discovery of gunpowder did in the past.

3. *Classes of Aerial Ships likely to be Used.*—Aerial ships may be divided into two distinct classes, viz., (*a*) navigable balloons, or machines lighter than the air; (*b*) flying machines, or machines heavier than the air. The chief characteristic of the former being that the weight is lifted by the gas in the envelope, while in the case of the latter, lifting power is obtained from the resistance of the air when the machine is moving at a high speed.

4. *Navigable Balloons.*—The best form of navigable balloons seems to be a fish-shaped envelope, underneath which is slung by netting the car containing the machinery, passengers, armament, &c. "La France," the balloon constructed by the French Government, was of this type, the envelope being 165 ft. long, about 23 ft. in diameter, total weight lifted about 4,000 lbs. The propelling machinery consisted of a screw-propeller in front of the airship, worked by an electric motor. A speed of about 15 miles per hour was attained on a calm day. In future steam or gas engines will probably be used instead of the "La France" type of motor as electricity is not at present light enough for aerial work. The new navigable balloon now being constructed by the French Government is an improved and larger "La France," and it is hoped to attain a speed of about 25 miles per hour in a calm. The advantages of navigable balloons are: First, that since the gas takes the weight, only propelling power has to be provided. Second, that any convenient speed can be adopted, while travelling through the air, and it is possible to stand still.

The disadvantages are: First, the envelope, on which everything depends, is very fragile. Second, no very great speed can be obtained; probably 30 miles an hour in a dead calm is the maximum as far as can be seen at present. Third, the risk of setting fire to the envelope if a steam or gas engine is used. Fourth, the difficulty of driving the machine against the wind. Fifth, unwieldiness in bad weather.

5. *Flying Machines.*—At present no full-sized flying machine has succeeded in leaving the earth, but several promising machines are in course of construction. A very general type is that adopted by Mr. Maxim, the well-known inventor. It consists of a large aeroplane, underneath which is hung a car containing passengers, engines, armament, &c. The machine, when starting, is run along a sort of railway line, the air pressure on the aeroplane lifting it up when a certain speed is attained. Very high speeds are expected from these machines, and 90 to 100 miles per hour does not appear to be an unreasonable estimate of their rate of travelling.

Another type of machine is that invented by Mr. Phillips, who uses a "sustained" or "aero-surface" in shape like a Venetian blind, but having curved instead of plain slats. The advantage of this type is that very heavy weights can be lifted, and consequently it is not necessary to build specially light engines for use with them.

The advantages of flying machines are: First, very high speed, and consequently less vulnerability. Second, the higher the speed *the less* the power required to drive the machine (within certain limits). Third, an opposing wind is an advantage, as it increases the lifting power, while a following wind is not disadvantageous if the machine is travelling faster than the wind.

The disadvantages are: First, it is necessary to move at a high rate of speed in order to keep up in the air. Second, the danger in case the aeroplane is destroyed (mere stoppage of machinery would not be dangerous). Third, the risk of carrying steam or gas engines in the air. Fourth, the difficulty of making accurate shooting when moving at high speeds.

6. *Armament of Airships.*—The armament of any class of airship is of two kinds. (1) That required for use against other airships; (2) that used to fire at objects on the earth or sea. The armament for use against other airships will probably be of a light pattern for two reasons. In the first, it is not likely that any very large airships will be built and consequently heavy guns could not be carried. Again, it is of the greatest importance to have only a moderate shock or recoil, otherwise the machine itself might be injured or shaken when the gun is fired. Probably therefore some light pattern of quick-firing gun will be used and the gunners will have to be specially practised in time of peace in firing at marks while moving at a high rate of speed. The guns used for firing downwards need only be of very small calibre with small propelling power as the force of gravity acts with the shells. Probably some form of pneumatic gun worked by compressed air or explosive gas will be used. As regards the projectiles the long cylindrical type will be adopted, heavily weighted with powerful explosives.

7. *Aerial Warfare as Affecting War by Sea.*—It will be readily acknowledged that existing navies are quite incapable of fighting against the airships described above; in fact it is no exaggeration to say that a good airship could destroy the best fleet now afloat in an hour with ease and safety to itself. What the type of sea ship will be in the future it is difficult to say, but it is plain that considerable alterations will have to be made in naval design and policy and that the introduction of airships will materially affect the position of those nations which depend for their defence chiefly on navies.

8. *Aerial Warfare as Affecting War by Land.*—In war by land one great advantage to the side which possesses the best airships will be the power of reconnoitring and ascertaining the position and movements of the enemy. With machines capable of moving at the rate of 90 to 100 miles per hour, far more extended reconnaissances will be possible and information will be transmitted far quicker. On the battlefield artillery and cavalry will be the chief sufferers while extended order must be generally adopted by all arms. Fortresses will still be of value, but the principles of their construction will have to be considerably altered, substantial head and gun cover being the first consideration.

9. *Warfare in the Air.*—Of warfare in the air, viz., airship *versus* airship, it is difficult to write. Probably the general lines of action will be similar to those of naval warfare, but far higher speeds will be used. The flying machines will no doubt be far superior to the navigable balloons.

10. *War in the Future.*—Wars in the future will probably commence with severe fighting in the air, the victor following up his successes with sea and land attacks (aided by airships) whenever possible.

But the chief work will be done in the air, and the arrival of the aerial fleet over the enemy's capital will probably conclude the campaign.

11. *Summary.*—To sum up:—

First.—It seems quite probable that in the near future aerial warfare will have to be counted upon.

Second.—This will, practically speaking, revolutionise the art of war.

Third.—Owing to the high rate of speed, which airships will attain, it will be necessary for all nations to maintain themselves ready for war at very short notice.

Fourth.—The nations most affected by the introduction of

aerial warfare will be those who depend for their defence upon navies.

Fifth.—As the aerial ships will be, comparatively speaking, inexpensive, the smaller nations will be able to equip themselves with them.

Sixth.—Owing to the possibility of war at very short notice a larger proportion of a nation will have to be kept under arms.

Seventh.—Warfare by sea or land will only be possible when a nation has the command of the air.

Colonel Fullerton's foresight was further emphasised in the following letter which he sent to the Royal Engineers' Journal in August, 1896 :—

With reference to Colonel Lewis's letter and other correspondence which has recently appeared in your columns on "Aerial Warfare" I venture to add a few notes on some points of general interest.

1. *Reconnoitring Airships.*—"Hovering" is possible, but cannot be trusted to, as it depends upon the strength and direction of the wind. It will, however, be just as convenient for purposes of observation if the machine slackens speed and moves above the object to be observed in circles or gently descending spirals. This can be done quite well.

2. *Firing at Objects on Sea or Land.*—Maxim's machine weighed about ten tons, and he expected to carry some two tons of explosives, stores, &c. This is no doubt a small amount, but as the number of airships would be large the total amount of explosives available would be considerable. The fire would be from some kind of gun, and as nearly vertical as possible, "fair-shaped" shells being used. Such shells would have very considerable striking velocity, even if only dropped, and they could easily be fired so as to have a striking velocity of some thousand feet per second. Aiming would not be so difficult as is generally supposed, as a ship or fort forms a very large target, while the range, say a height of 4,500 ft. per 1,500 yards, would be small. The very great advantage of having the forces of gravity acting in favour of the gun instead of against it is, I think, hardly yet appreciated.

3. *Fire at other Airships.*—The conditions in this case would be very similar to those of naval warfare, except that the speeds would be considerably greater, and that the constant variations of the positions of the airships in a vertical plane would add considerably to the difficulties of the firers. No doubt it would be a great advantage to have the "upper position," but light guns could be mounted above the aero-surface, and thus to a certain extent neutralise this advantage.

4. *Fire from Ships or from the Ground at Airships.*—No doubt all sorts of strange guns will be invented for hitting airships, but the difficulties do not lie so much with the guns as with the gunners. The airship painted lead colour, so as to be almost invisible in average weather, will offer a very small target, and its speed will be such as to render taking aim by no means an easy matter. Cloudy rainy weather will also be an advantge to the airship, as it will enable it to appear and disappear with great rapidity, thus considerably increasing the difficulty of taking aim at it.

5. *"Dropping" versus "Firing" Shells.*—I do not quite agree with Major Moore on this point, as unless the shells were very heavy, they would not have sufficient striking energy for use against ships. Of course, against troops in close formation (especially cavalry and artillery) almost any method of dropping or firing shells would be highly effective.

6. *Firing at a Five-acre Field.*—Such a field is equivalent to a target 350 yards long by 70 yards wide; at a height of 4,500 ft. there would be no difficulty in hitting it (or a very considerably smaller target), shot after shot, with the greatest ease.

METEOROLOGY IN RELATION TO AERONAUTICS.*

By W. H. DINES, D.Sc., F.Ae.S., F.R.S.

THE ordinary data that are observed at a meteorological station are the following :—The temperature, the barometric pressure, the humidity, the rainfall, and the strength and direction of the wind. These elements are recorded at many stations by automatic instruments, at other stations eye observations are made at stated hours each day, so that there is at the present time a vast accumulated mass of information, more indeed than some think is needful, and the mean value of any of these elements at any time of the day or year and in any part of the British Isles is fairly well known. Observations are also made of the current phenomena such as fogs, thunderstorms, snow, &c.

I propose to take these data in order and consider their bearing upon aviation. They are readily obtainable at the time and place of starting, but the aviator requires them for the height up to which he proposes to fly and for the future time during which he is to remain in the air.

The Temperature.—The temperature of the air is not of itself, perhaps, of very great importance, though the cooling of the engine and the comfort of the airmen depend upon it to some extent, but the temperature has more effect upon the density of the air than any other element, except the pressure, and since the lifting power of the machine for the same speed varies as the density, and also a correct measure of the height depends upon it, it is necessary to discuss first the conditions that usually prevail with regard to temperature.

It is and has been for long past perfectly well known that an increasing height is in general accompanied by a falling temperature. Even in the Tropics it is possible to reach the level of perpetual snow on the mountains; and in Scotland, although none of the mountains are high enough to reach the snow line, yet in many places the winter drifts do not entirely melt, so that snow may always be found.

The reason for this decrease of temperature is fairly simple. As air comes under the decreased pressure of a higher level it expands, and expanding air is cooled by its own expansion. The converse process is apparent to a person using a bicycle pump, the air has to be compressed to be driven into the tyre, the compression occurs in the lower part of the barrel, which in consequence may become too hot to touch. The whole process is known as dynamic heating and cooling and to it chiefly the fall of temperature with height is due, although some small part of the effect may be due to the laws of radiation. The fact that the upper layers of air are nearer the sun is sometimes brought into the discussion of this question. It seems almost superfluous to point out that the few miles difference of distance is utterly insignificant in comparison with the distance of the sun, viz., ninety million miles.

The following figures give a general idea of the fall of temperature with height. Like all other figures given in this paper, unless the contrary is expressly stated, they refer to England, and more particularly to the South-East of England, but they will hold without much error for latitude 50° to 55° N.

TABLE I.

Height.		Temperature.			
Kilometres.	Feet.	Jan.	April.	July.	Oct.
Surface ..		276	82	89	83
1 ..	3,281	71	76	83	79
2 ..	6,562	67	70	78	75
3 ..	9,843	63	65	73	70
4 ..	13,124	57	59	67	64
5 ..	16,405	50	52	61	58
6 ..	19,686	43	46	55	51
7 ..	22,967	37	39	47	45
8 ..	26,248	30	32	41	38
9 ..	29,529	24	26	34	31
10 ..	32,810	20	22	26	24
11 ..	35,091	17	19	22	20
12 ..	39,372	17	20	22	19
13 ..	42,653	16	21	23	18
14 ..	45,934	16	21	22	17

The temperatures are given for a reason subsequently explained in absolute measure, C., with the first 2 omitted. On this scale 273 is the freezing point, 50° F. corresponds to 283°, − 4° F. to 253°, − 40° F. to 233°, and − 67° F. to 218°.

The fall of temperature for a given height is called the temperature gradient; but inasmuch as the term "gradient" is so commonly applied to changes occurring in a horizontal direction it seemed better to avoid the term to denote a change in the vertical direction, and hence "lapse rate" has been suggested. The lapse rate is usually measured in degrees Centigrade per kilometre because the observations have very largely been made in connection with an international scheme and uniformity of units is essential. A rate of 10° C. per km. is equivalent to 5.49° F. per 1,000 ft.

The case when the temperature rises instead of falls with increasing height is called an inversion; inversions are common in the lower strata, and the fall of temperature nearly always ends with some sort of an inversion at a height between 8 and 13 kms. (5 and 8 miles).

Broadly speaking, the average lapse rate up to 30,000 ft.,

* Paper read before the Aeronautical Society of Great Britain on Wednesday, December 5th, 1917.

the only part of the atmosphere with which we are concerned, is the same all the world over, so far as we know, excepting where the temperature is very low, as it is in Canada, Siberia, &c., in the winter. Very low temperatures with calm and a clear sky nearly always, perhaps always, have an inversion over them, so that although the winter temperature in Russia is much below that in England at 6,000 ft. the difference is not nearly so large. But near the equator the lapse rate for the first few kilometres is about 5° per km., increasing to 7° or rather over at higher levels just as in England, but it is curious that over the Tropical regions the fall is continued to a much higher level to 16 or so instead of to 10.5 km. as over England, with the result that the lowest natural temperatures ever registered have been found at a height of 10 miles over the equator. There are not enough observations to give a very accurate mean value, but it is about −80° C. whereas over England it is −53° C.

The values in the table are for England. The annual range that we have at the surface is seen to extend upwards to about 10 to 11 kms., say 7 miles, or 35,000 ft. The times of the lowest and highest temperature in the South-East of England at the surface occur in January and July, but above some 5,000 ft. these dates occur about a month later. Thus, other things being equal, the temperature decreases with height more rapidly in the spring than in the autumn months. The difference, however, is not great enough to be of much practical importance.

The daily range of temperature is quite small at a few thousand feet above the earth's surface, as indeed it is also over the sea, but it is large at inland stations in clear weather near the ground. The lapse rate in the first few thousand feet is therefore very dependent on the time of day. About sunrise in calm clear weather there will nearly always be an inversion in the first thousand feet, so that an aviator will rise quickly into warmer air. On the other hand, on a sunny afternoon in late spring or summer the fall of temperature for 3,000 ft., perhaps for 5,000 or 6,000 ft., will be as great as the conditions of equilibrium per unit. This rate, known briefly as the " dry adiabatic "—it refers only to air in which clouds are not being formed—is 1° C. per 100 metres, or 1° F. per 190 ft.

The lapse rate also depends upon the height of the barometer, being much greater in the lower strata when the barometer is low than when it is high. With a deep cyclonic depression, barometer 29.00 at mean sea level, the probable temperature at 7 km. height (23,000 ft.) is − 39° C., whereas with an anti-cyclone, barometer 30.30, it is probably − 27°, a difference of 12° C. (21.6° F.), about equal to the difference between January and July. With a low barometer the lapse rate is large up to say 9 km., but ceases there, with a high barometer the lapse rate is small up to 5 kms., there is in most cases an inversion somewhere under 6,000 ft., but the fall of temperature is continued to say 12 kms., or maybe 13 kms., with the result that the upper part of the atmosphere, a part far beyond the reach of any aeroplane, is much colder over the anti-cyclone than over the cyclone.

An inversion of temperature is found, too, I believe invariably, over a certain type of stratus cloud. At least, on every occasion on which I have succeeded by means of kites or balloons in getting an observation, an inversion has been found. An inversion is not, however, present over every cloud sheet. The type of cloud I mean is a thin cloud, generally with gaps in it, which permit stars or the moon near the zenith to be seen, but do not permit the winter sun, on account of its low altitude, to be seen. It is common in winter when the barometer is high.

The Barometric Pressure and the Density.—The aviator is affected by the barometric pressure in many ways. The density on which the lift exerted on the wings of his machine depends is proportional to it, the running of his engine is influenced by it, and his aneroid which purports to show him his height, although the scale may be marked in feet, really shows him the pressure and nothing else. His speed indicator also depends on it.

The direction and strength of the upper wind depend upon the distribution of pressure, but this matter will be considered under the heading " Wind."

The barometric pressure is simply the weight of the overlying air. The air consists of a mixture of various permanent gases, the proportions in which these gases are mixed being constant, together with a certain quantity of water vapour, the proportion of which to the whole is very variable. But the actual percentage of water vapour in the air in these latitudes is small and its effect upon the density is trifling, and we may in this connection neglect it without serious error.

The average barometric pressure at sea level is about 15 lbs. on each square inch, which means that if we take a column of air of 1 sq. in. cross section reaching up from sea level to the top of the atmosphere the air in such a column will weigh 15 lbs. At greater heights the overlying column is of course shorter and therefore of less weight, and the problem of determining the height of an aeroplane is that of knowing what weight of air corresponds to a given length of air column. The altmeter, as previously stated, measures only the pressure, and the difference of pressure must be translated into length of air column. This would be easy enough if only the same length of column always corresponded to the same difference of pressure, but this is not the case.

What is actually done is to assume certain definite conditions, but these conditions are not always found, and when they are not found a correction is required.

This was of some importance in days when an acute competition to attain the maximum height was in progress. As Captain Tizard pointed out, the real test is to reach the lowest density and the same density is not always found at the same height. But the public understand what is meant by height, but not what is meant by density, and therefore the competition to hold the record for height is likely to continue.

For convenience of reference the formula connecting the pressure and the height and the simple principles on which it rests are set out below.

The pressure, temperature, and volume of a definite quantity of the atmosphere are connected by the equation PV/T equals a constant, where P is the pressure, V the volume, and T the temperature on the absolute scale. This is an experimental fact and is commonly known as the gas equation. If we prefer to measure temperature on the Centigrade or Fahrenheit scale for T we must write $273 + t$, where t is the temperature Centigrade, or $455 + t$, where t is measured in degrees F. The gas equation is of such constant use in theoretical meteorology and in physics and it is so much more convenient to have a single term T to deal with than a compound term like $273 + t$, that it is becoming usual to measure and record temperatures in the absolute scale.

The density of a body is its mass divided by its volume. Since in the gas equation we are considering the changes of pressure, &c., of a definite amount or mass or air, if we introduce the density (D) instead of the volume, since $D = M/V$, the equation takes the form $P/DT =$ a constant.

That is the density of a gas varies directly as the pressure and inversely as the absolute temperature. At the surface variations of pressure to the extent of 4 per cent. below and 2 per cent. above its mean may easily occur; and variations of temperature over the range 20° to 80° F., giving 6 per cent. on either side, may equally well occur. It so happens that very high temperatures and low heights of the barometer do not occur simultaneously, but variations of density to the extent of 8 per cent. from the mean on either side are not impossible. The variations of density at heights above 5,000 ft. are very much smaller; this is because it is the general rule that from that height upward to 30,000 ft. high pressures and high temperatures occur together and conversely, so that the two causes of variation act in opposite ways and partly cancel each other out.

Since in an aeroplane the pressure can be got with fair accuracy from an aneroid and the temperature from a thermometer the density can be determined. A knowledge of the density is necessary before the proper correction can be applied to the speed indicator, the indications of which depend directly on the density.

To obtain the true height is much more difficult and requires a knowledge of the temperature not only at the point, but at each step of height upward from the ground. The formula connecting pressure and height is obtained thus. If we consider a height h above sea level the difference in pressure between sea level and the height h is the weight of the intervening column of air. This weight is proportional to the density—that is, as shown above, it is proportional to the pressure and inversely proportional to the absolute temperature. But neither the pressure nor the temperature is the same at the top and bottom, and we must therefore calculate the height by steps, taking h so small that we may without appreciable error use the mean value of P and T over the column. If we assume T constant we can take account of the variation of P and obtain an exact formula thus :—

Consider a column of air of cross section A at the bottom of which the pressure is P. Then ascend a very small height δh to a point where the pressure is $P - \delta P$. The whole pressure on the bottom is AP and the whole pressure on the section at the height δh is $A(P - \delta P)$. The difference $A\delta P$ is the weight of air in the length δh of the column. The

weight equals the mass × acceleration due to gravity, and the mass is the volume × the density. The volume is $A \times \delta h$, hence $-A\delta P = gDA\delta h$. The density equals kP/T where k is some constant.

Hence $$-\delta P = gk\frac{P}{T}\delta h$$

or $$\delta h = -\frac{T}{gk}\frac{\delta P}{P}.$$

Integrating $$h = -\frac{T}{gk}\log_e P + \text{a constant}.$$

Let h be measured from sea level at which the pressure is P_o, then to determine the constant we have $h = o$ when $P = P_o$.

$$\therefore h = \frac{T}{gk}(\log_e P_o - \log_e P) = \frac{T}{gk}\log_e \frac{P_o}{P}(T).$$

We can change to common logarithms by dividing by 2.3026, hence, $h = \mu T \log P_o/P$ when μ is a constant dependent on the units in which h is measured. In feet $h = 221.13\ T \log P_o/P$, and it will be seen that as the ratio of the pressures only is involved the unit in which they are expressed is immaterial. As an example, suppose there is a uniform temperature of 50° F. which is equivalent to 283° A, and that the barometer stands at 30 ins., to find the height at which we have the barometer at 27 ins. we have—

$h = 221.13 \times 283 \times \log. 1.11111 = 2{,}863$ ft.

When integrating to obtain equation (1) it was assumed that T was constant, but in actual practice the temperature is arbitrary, and bears no fixed relationship to the pressure. For the actual conditions therefore (1) is not rigorously exact, but the error will be inappreciable, not more than 1 ft. in a thousand, if the mean temperature of the column be used and if h does not exceed 10,000 ft. For heights of the order of 30,000 ft. the error, even if the correct mean temperature be used, may reach nearly 1 per cent. Hence, for great heights the only way is to proceed by steps, determine the pressure at, say, 10,000 ft., and then use that for the starting point for the next 10,000, and so on.

In the "Computor's Handbook," published by the Meteorological Office, tables are given showing the factor for all temperatures between 200 and 300 A, by which the pressure at any height must be multiplied in order to obtain the pressure at the point 1 kilom. higher. The effect of the humidity and the variation of gravity is also shown.

In equation (1), if h is put equal to 1,000 ft., the ratio P/P_0 for any assigned value of T is readily attained. The values for a few temperatures are shown below, and by multiplying the pressure at any height by the given factor the pressure 1,000 ft. higher is obtained

Temperature:

200 210 220 230 240 250 260 270 280 290 300

Factor to give pressure 1,000 ft. higher:

.9505 .9529 .9551 .9571 .9589 .9605 .9620 .9635 .9648 .9661 .9672

Capt. Tizard has given a table of average densities at each 1,000 ft. up to 20,000.

From what has been said above about the variations of temperature and the manner in which the pressure at any precise height is dependent on the pressure at the ground and on the temperature between the ground and the height considered, it will be seen that when no temperature observations away from the ground are available, to determine the precise value of the density is impossible. But we can advance a stage beyond, being content with the average value. We might prepare tables giving the average for each month, but this would not be satisfactory, since it would ignore the conditions of pressure and temperature prevailing at the time, conditions which are important and easily measured.

The lapse rate, apart from its daily variation at inland stations in the first kilometre, is the least uncertain of the different variable elements which define the atmospheric conditions, and on this basis I have prepared a table of corrections in terms of the pressure and temperature at the surface to be applied to Capt. Tizard's values of the average density.

It is too long to go into details, but from some 200 observations made in the southern part of England tables have been prepared showing the fall of temperature between the ground and various heights in terms of the height of the barometer. From these tables by the ordinary statistical method of calculation the most probable value of the pressure and temperature at any point up to 30,000 ft. has been found and from thence the density.

The values are given in percentages, so that they may be applicable to any units in which the density is expressed. The mean sea-level pressure in the south-east of England is a little over 760 m.m., or a little under 30 ins. of mercury. The mean temperature is 50° F., 10° C., or 283° A. Thus, if we require the most probable density at 10,000 ft. when the barometer is 29.50 and the temperature at 32° F., proceed thus: 29.50 is .50 in. below the pressure mean, the correction is therefore $-.012 \times .50 = -.006$. The temperature is 10° below, and the correction is +.013. The whole correction is +.007, and we must multiply the average density by 1.007.

For heights of and above 4,000 ft. this table is probably the best that can be done under the present state of our knowledge, and it should in most cases give the density within 1 per cent., but the following remarks are necessary.

Over the open sea or at a coast station, with a fairly strong wind off the sea, the surface temperature at the start is to be used. At an inland station or a coast station with an offshore wind, the mean temperature for the day is to be used in preference to the surface temperature at the time, because the latter is purely local and depends so largely on the time of day.

TABLE II.

Percentage additions to be made to the density at different heights to allow for variations from the mean of the surface pressure and the surface temperature.

Height.	Pressure difference in ins. at surface.	Temperature difference in degrees F. at surface.	Height.	Pressure difference in ins. at surface.	Temperature difference in degrees F. at surface.
Surface	+.033	−.0020	16,000 ft.	+.012	−.0009
2,000 ft.	+.026	−.0018	18,000	+.013	−.0008
4,000	+.020	−.0017	20,000	+.015	−.0006
6,000	+.016	−.0016	22,000	+.017	−.0005
8,000	+.013	−.0015	24,000	+.020	−.0003
10,000	+.012	−.0013	26,000	+.025	−.0002
12,000	+.011	−.0012	28,000	+.033	−.0000
14,000	+.011	−.0011	30,000	+.044	+.0002

The correlation coefficients between the lapse rate and the height of the barometer on which Table II is based range as a rule from .30 to .50; they are not large enough to make the estimate very reliable, but they are sufficiently large to make it worth while to take the surface pressure into account. There are so many variable quantities involved that the question is very complicated, and it is perhaps of more importance for long-range artillery fire than for aeronautics.

The humidity.—The humidity is an important matter for aviation, inasmuch as fog, clouds, rain and snow depend upon it. But the value of the humidity is only of use for the forecasting of fog, and this matter has been so fully dealt with in a lecture given here on February 28th, 1917, by Major Taylor, that I have nothing further to say about it. Instead, therefore, of wasting time on the subject I will refer to his remarks, published in *Aeronautical Journal* Vol. XXI, p. 75, and also to a paper by Capt. Cave, published in the same volume, p. 301, in which the dangers due to rain and snow are mentioned.

(*To be continued.*)

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Gallant Rescue of Seaplane Pilot.

IT was announced in the *London Gazette* of December 14th, that the King has been pleased to award the Albert Medal in Gold to Nicholas Rath, Seaman, R.N.R., and the Albert Medal to Richard Knoulton, Ordinary Seaman, R.N., and George Faucett Pitts Abbott, Deckhand, R.N.R. (Trawler Section), in recognition of their gallantry in saving life in the following circumstances:—

"On September 14th, 1917, a seaplane came into collision with one of the masts of a shore wireless station and remained wedged in it, the pilot (Acting Flight Commanedr E. A. de Ville) being rendered unconscious and thrown out of his seat on to one of the wings. The three men above mentioned, at once climbed up the mast for 100 ft., when Rath, making use of the boatswain's chair, which moves on the inside of the mast, was hoisted up by men at the foot of the mast to the place, over 300 feet from the ground, where the seaplane was fixed. He then climbed out on the plane, and held the pilot until the arrival of Knoulton and Abbott, who passed the masthead gantline out to him. Having secured the pilot with the gantline Rath, with the assistance of Knoulton and Abbott, lifted him from the plane to the inside of the mast and lowered him to the ground. The three men were well aware of the damaged and insecure condition of the mast, which was bent to an angle where the seaplane had become wedged. One of the three supports of the mast was fractured, and, so far as the men knew, the mast or seaplane might at any time have collapsed."

AIRISMS FROM THE FOUR WINDS

SIR WILLIAM WEIR'S appointment, by the Minister of Munitions, as Director-General of Aircraft Production spells strength of purpose and organisation. On December 14th, both the President of the Air Board, Lord Rothermere, and Sir William Weir were received by the King at Buckingham Palace.

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ALTHOUGH the new title of Sir William is somewhat different to that of Controller of Aeronautical Supplies, under which he has hitherto carried out such effective national work, much the same work will remain with Sir William. It is the fact that he is able to remain, strengthened, under the new Air Ministry, that counts. His energy as seen as Director of Munitions in Scotland, will find an unlimited field for development with the Air Force.

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REAR-ADMIRAL ROBERT E. PEARY, of the United States, is optimistic and emphatic upon the future, and particularly the carrying capacity of aeroplanes in the days to come. He says that perhaps before the war is over, but certainly in the next war, if we have another, aeroplanes will carry artillery as heavy as the famous French 75's, and when that time comes the aeroplane will be invulnerable. It will be able to soar over any field, water, or mountainous country, carry enormous numbers of troops far behind the enemy lines, and do the work of cavalry, infantry, and artillery combined. Admiral Peary, who has been intimately concerned with the development of a great aerial programme for America, also predicts German attacks in the not far distant future, on American coast cities.

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MORE and more aeroplanes without question are needed for a successful issue to the war. Yet the waste and dissipation of man-power in the past for their construction must have been appalling, simply for want of a little imagination in those who have had the calling of the tune, whilst the mere civilian has had the privilege of paying the piper. In this connection, by way of instance, organ-builders have, it is stated, proved to be among the best aeroplane makers, yet the Federation of Master Organ-builders points out that the whole of the craft might have been secured for the work if the Government had accepted their offer, made nearly three years ago, of factories, plant, and staffs for the duration of the war for the manufacture of war material, including aeroplane parts. With the gradual stoppage of work, organ-builders, so states the Federation, have had to close down. Not only, therefore, has the opportunity been lost for making the best use of these skilled men, but also the task of restoring to its former pre-eminent position an industry now plunged in ruin has been rendered exceedingly difficult. It would appear to have been about time a firm hand grappled with the all-important National Service problem. Under present-day conditions Sir Auckland Geddes' task is hardly an envious one, but he appears to be grasping the nettle with a pretty firm hand, and there is distinct promise of a drastic change in methods, whilst a proper sense of proportion in the nation's requirements is not being lost sight of.

BY way of further instance in this direction of official muddles, take the remarks only the other day of Sir Donald Maclean, chairman of the House of Commons Tribunal, upon the indifference with which some Government Departments regard offers of service by skilled men. The case referred to by Sir Donald, was that of a man named Bridgland, B 1, aged 40, an engineer and fitter. Several adjournments had been granted to enable him to obtain work in the R.F.C.

His counsel, Mr. Frampton, related how Bridgland went to the local recruiting officer and was referred to the Polytechnic. Then he was sent to Farnborough, and after the tribunal had granted another adjournment he was taken on at Kingston Barracks to undergo tests, and later sent to Woolwich for the same purpose. When he applied at the Board of Trade he was told that they had no use for his services, and it was suggested that his employer might take him back. Eventually he was put into khaki on December 1st, posted to the Mechanical Transport, A.S.C., as a learner, and *put on washing floors and plates.*

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AT this stage, Sir Donald said "I wish the Ministry of National Service could hear this recital. It gets more and more tragic as the war goes on. It is no longer a comedy; it is just a tragedy. He is a skilled man, 40 years of age, and is now on fatigue duty washing plates. He has no right to be put into the Army, especially incidentally for the purpose of washing plates."

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TRULY it is indeed a tragedy, especially when taken in conjunction with the progress of German aviation efforts as set out by Mr. G. H. Perris, the *Daily Telegraph* correspondent, who is in close touch with the French Armies at the front. "By the efforts of the past year which I recently reported," Mr. Perris writes, "General von Hoeppner has brought the strength of the German aviation services up to rather more than 200 squadrillas, representing a total of about 2,500 machines. They are divided as follows: Bombarding squadrillas, 23; chasers, 40; protection squadrillas, 30; patrol squadrillas, 80; artillery squadrillas, 100; total, 273. To these groups must be added the aeroplanes and hydroplanes of the Navy, a dozen or more garrison squadrillas, and about a dozen training groups."

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MR. PERRIS continues: "I have before me a detailed account of the fate of rather more than fifty Zeppelins, which explains in the most satisfactory manner why these prodigious vessels no longer frighten the world, and so far as land operations are concerned can no longer be seriously counted in the air services. Apart from two destroyed before the war, the list may be summarised as follows:—Destroyed in Germany, 5; destroyed in neutral countries or near the front, 5; destroyed in England, by the British Navy, or on their way home from England, 15; others destroyed at sea, 2; out of use, 5; in use as training-schools, 4; in use chiefly in the North Sea, 9. Considering the millions of pounds spent and the unlimited hopes built upon these monsters, we may regard the result as one of the most conspicuous fiascos in the history of industrial and military science."

A German single-seater fighting biplane of the F. F. (Flugzeugbau Friedrichshafen) type.

MINISTERS AND OUR AIR POLICY.

THE Prime Minister and the heads of the Air Service were the guests at a dinner given last Friday night at Gray's Inn by the Treasurer, Sir Frederick Smith, K.C., M.P., the Attorney-General, and the Masters of the Bench of the Honourable Society of Gray's Inn.

The gathering included the Archbishop of Canterbury, the Home Secretary, the Lord Chancellor, the Lord Chief Justice, the Duke of Westminster, the Italian Ambassador, the American Ambassador, Admiral Sims (U.S. Navy), Lord Rothermere (Air Minister), Sir Edward Carson, General Smuts, Lord Derby, Mr. Churchill and Mr. G. N. Barnes, M.P.

Sir Frederick Smith, in introducing the Prime Minister, said one object of the dinner was to mark and place on record their appreciation of that great consolidation of our Flying Services which had produced the new Air Service. They had present men who in almost every department had made that service.

Mr. Lloyd George, at the commencement of his speech, said :—

Let me express how honoured I feel to be invited to this historic building to meet representatives of the most romantic service in this war. In the House of Commons I gave what I fear must be regarded as inadequate expression to the gratitude and admiration which the nation feels for this gallant service. I have some times felt that the operations of the Air Service will, probably, have greater effect in determining the nations that this must be the last war than any other weapons, however terrible their effect. They bring home to the people, who in former wars dwelt in security, something of the perils and the horrors of the battlefield; and, as the war goes on, these will spread and increase and intensify. These winged messengers of death, therefore, may well be angels of peace. But we must also remember that, while all that is true, they also give a greater significance and permanence to either victory or defeat. For, however unjust or oppressive might be the peace imposed on us, the new terror added to war by this new weapon of dismay will create an increased reluctance on the part of the world to challenge the issue anew. It is, therefore, more important than ever that the peace we secure should be a just, an honourable and a beneficent peace.

Sir Frederick Smith, in proposing the health and prosperity of the Air Service, said that it might well be that in the next twelve months the future of the war would be determined by the conquest of the air. That could only be if there were harmony and co-ordination among all those who were mastering the enemy in the air. If there was competition between the Army and Navy and a third element of competition by some neutral, or hermaphrodite, board, it was evident that there could never be success. There was present that night the new Secretary of State for the Air, and they believed that the great task which lay before him would not be complicated by inter-Service jealousies. His difficult task would be made more difficult, and even insurmountable, unless the military and naval Services determined that they would make it easy, and his (the speaker's) appeal to them was that they would make up their minds that there should be no controversy between Army and Navy.

Lord Rothermere, in reply, said that in the creation of the new force a great work of consolidation and unification was called for. When, in succession to Lord Cowdray, he decided to go " over the top " with the Prime Minister, and accepted the position of Air Minister, he did so with the full confidence that the two senior Services, the Navy and the Army, would extend ungrudging assistance and support to the new Service, the Air Force, which is now being established.

Lord Rothermere continued:—My brief experience of a fortnight has proved to me that my confidence has not been misplaced. I feel that, instead of the rebuff which people prophesied, I shall, whenever I require assistance, find a helping hand extended to me both by the Navy and the Army. Without such assistance it would be impossible for any man to make a success of the position I hold. It is no easy matter to dissever the aerial branches of the Navy and the Army and weld them into one whole. It is a gigantic work of organization. The Royal Naval Air Service and the Flying Corps are two distinct bodies with different ranks, different rates of pay, and different organisations.

At the Air Board we are wholeheartedly in favour of air reprisals. It is our duty to avenge the murder of innocent women and children. As the enemy elects, so it will be the case of " eye for an eye, and a tooth for a tooth," and in this respect we shall slave for complete and satisfying retaliation. General Ludendorff proclaims the war a war of nations, suggesting that the civilian population is as much a mark for the airman's bombs as the fighting man. We detest these doctrines, holding them to be grossly immoral. But in fighting for our lives and the lives of our women and children we cannot, and we will not, consent to their one-sided application. We have too much at stake in this contest to concede any advantage to a treacherous enemy. He has to learn in this as in larger things that it does not pay. We are determined, in other words, that whatever outrages are committed on the civilian population of this country will be met by similar treatment upon his own people.

The great asset of the Flying Services, Lord Rothermere added, was the young Briton, whether born in these islands or in the Dominions oversea. He made the ideal fighter, courageous, daring, with heaps of initiative. Our duty was to see that he obtained all he wanted. His brief experience taught him that the production of aircraft in great numbers was not the easy task that many people imagined. If the aeroplane had reached its ultimate development the task would not be anything like so difficult, but hardly a month passed without some step, very often a great step, being made in the improvement of the aeroplane. The output of machines had increased in a most satisfactory way, and he had no doubt that at the present rate of progress it would not be long before the many criticisms which have been levelled at the Air Ministry were silenced.

He was reminded by that gathering in so famous a place that the greatest of their Treasurers, Lord Chancellor Bacon, had perhaps given an Air Minister of to-day the best advice that he could gain from the " wisdom of the ancients." " The conditions of weapons, and their improvement," he said in his famous essay " Of Vicissitude of Things," " are, first, the fetching afar off." (And what hits or " fetches " farther off than an aeroplane ?) " Secondly, the strength of the percussion "; and " the third is, the commodious use of them; as that they may serve in all weathers; that the carriage may be light and manageable; and the like." Lord Rothermere concluded :—Here, if I need it, the great ghost of Gray's Inn give me not only inspiration, but actually sound advice. My coming here to-day has served to remind me of it.

Commodore Godfrey Paine and General Sir David Henderson responded for the naval and military interests of the Air Ministry.

General Henderson said that the only rivalry between the naval and military air forces was the inevitable rivalry between any two organisations which were doing practically the same work by different systems. He was confident that there was no cause for apprehension and that the two services would amalgamate, so far as *personnel* was concerned, without any grudge of any kind. He was confident that the Air Services would trust Lord Rothermere, and would join up and make one service, and a very good service too. The R.F.C. and the R.N.A.S. had never lost touch altogether. He knew that they would now come together once and for all.

Commodore Paine said that the greatest of the achievements of the Navy had been silent with monotonous watching, and with none to applaud. The competition between the Naval Air Service and the R.F.C. had been one to test which was the best in the air. He believed that it had been greatly exaggerated, and he hoped that the new service would guarantee the security of the country.

Two British Airships Lost.

THE Secretary of the Admiralty made the following announcement on December 15th :—

" A British airship of non-rigid type, with a crew of five, which proceeded on patrol on December 11th from an East Coast base, has not returned, and from information available it is believed that she has been destroyed by a hostile seaplane in the southern part of the North Sea.

" A second airship of similar type was forced to descend in Holland through engine failure on December 12th."

According to unofficial information, the British airship No. 26 fell on some houses at Eemes (Utrecht), at 6.30 a.m. on December 13th. The engines—12 and 14-cylinder Daimlers—were still working, but no one was in the car. Four of the occupants had jumped out in an effort to anchor the airship, but a gust of wind carried it away. The remaining occupant, William Wasman, the wireless operator, was found near Dordrecht, having apparently fallen out of the car. He stated that the airship, owing to engine trouble, drifted out to sea and lost her bearings in a thick mist.

FLIGHT

LONDON TO CONSTANTINOPLE BY AIR.

By way of celebrating the Constantinople bombing expedition, carried out by the H.P. machine with Rolls-Royce engines, and the smashing of the "Goeben," &c., a gathering at luncheon last week had the pleasure of listening to a recital of the details leading up to that very all-British exploit. Lord Herbert Scott presided over a gathering which included many distinguished officers and engineers. Unfortunately, the heroes of the adventurous aviation exploit, Squadron Commander Savory and Lieutenant McClaren, could not be present. To the invitation sent out to them a long-delayed reply was received from "Somewhere in France," which was to this effect: "We are too busy killing Germans."

Mr. Handley Page recounted the very fascinating story of the journey as follows:—

"The machine, which flew from Hendon to Constantinople, was a Handley-Page twin-tractor biplane, equipped with two 275-h.p. Rolls-Royce engines. It was a standard machine in every respect, complete with normal tanks and bomb-dropping gear, and the engines with which it was fitted were standard Rolls-Royce aviation engines. On board were the pilot, Flight Commander Savory; the second pilot, Lieutenant McClellan, who flew the machine in turn with Commander Savory, the engineer, Lieutenant Rawlings; and two mechanics. There were also all their luggage, beds and bedding, two tool-boxes containing the spares and tools for the engines, and a further consignment of spares, practically equivalent to a further engine. To complete the equipment there was strapped on the side of the fuselage two 11 ft. 6 in. four-bladed propellers, covered over with a tarpaulin, the whole being very securely fixed to the side of the fuselage. Complete, the machine was over six tons in weight, and as its weight when light was about 8,000 lb. a useful load of no less than 6,000 lb. was carried on this flight.

Setting out from Hendon, the company of five reached Paris, and flew through France down the Rhone valley to Lyons, and on to Marseilles. From Marseilles they flew to Pisa, and thence to Rome, where they landed. The aviators were received by the heads of the aeronautical staff there, and a very hearty welcome was extended to them. From Rome the battleplane proceeded to Naples, and on to Otranto. Crossing the Albanian Alps the aviators flew on to Salonica, and thence to their base to prepare for the final stages of the trip to Constantinople, which involved flying 250 miles over a hostile country, under conditions equally arduous as that of Chavez's flight across the Alps.

"While flying across the Albanian Alps the airmen could see the hostile Bulgarian horsemen chasing them, in the hope that their machine might be forced to descend and give the crew as prisoners into their hands. Cross winds, clouds, and all kinds of atmospheric disturbances rendered the latter portion of the voyage most difficult and perilous. The mountain peaks range from 8,000 ft. to 10,000ft. in height. Happily, the engines never failed for one moment, and even with the heavy load on board there was never the slightest fear on the part of the pilots that any trouble would arise.

"After a short rest at their base, and careful overhauling of the machine the airmen set out on what was the culminating achievement of their wonderful flight. The bombing of the Turkish capital was done at night. A 2½ hours' journey brought the two pilots and engineer left to man the aeroplane over the Sea of Marmora, and straight up the Sea of Marmora they headed for the attack on the Goeben and the Turkish capital itself.

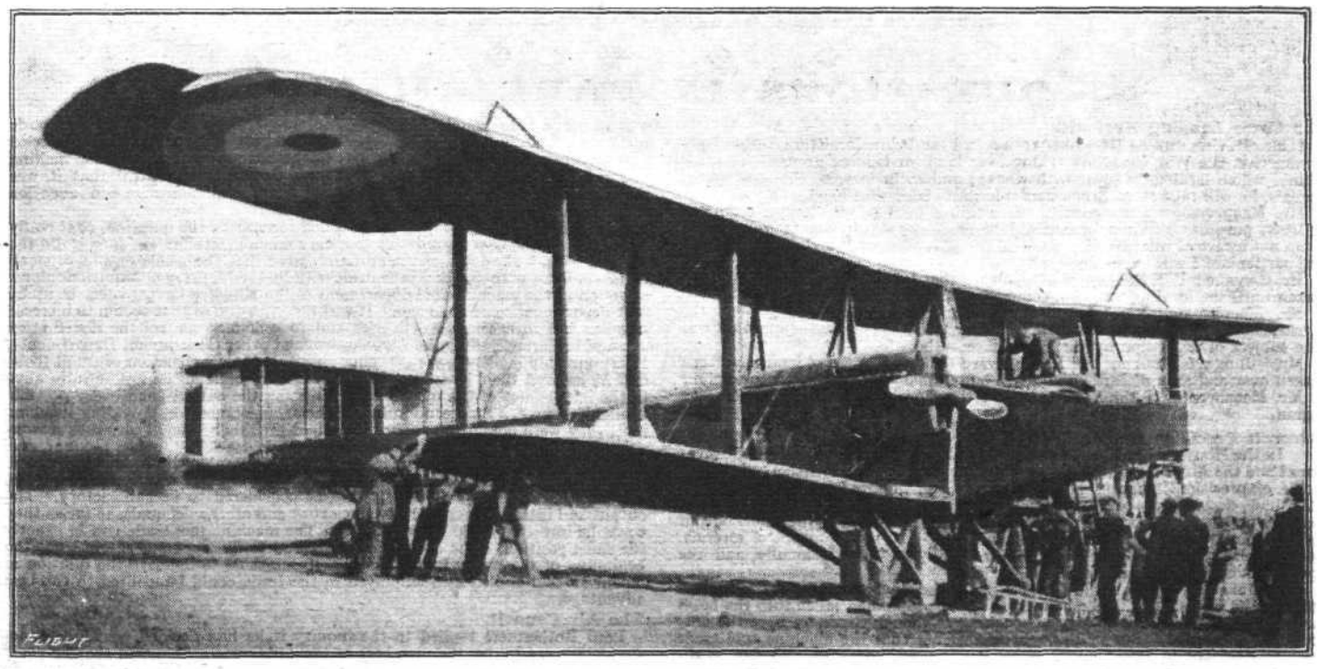
"Constantinople was reached when flying at a height of 2,000 ft., and there, lying beneath them, could be seen the "Goeben" with all lights on and men walking on deck. Constantinople itself was brilliantly illuminated. The Golden Horn was clearly silhouetted.

Once the aeroplane flew along a line parallel with the "Goeben," so as accurately to determine its speed and give the necessary data for bombing. Circling twice, the machine dived down to 800 ft., and a salvo of four bombs was released. The first salvo missed the "Goeben," but exploded against one or two submarines lying at its side. Again the aviators flew round, in order to make certain of their aim, and this time they hit the "Goeben" with four bombs.

"The dropping of the eight bombs seemed to disconcert the Turks, for all lights suddenly went out. The pilots then made off towards the Golden Horn, and dropped two more bombs on the ship called the "General," which was the headquarters of the German General Staff. Finally, they flew over the Turkish capital and dropped two more bombs on the Turkish War Office, which in the words of the Turkish Communiqué, "was not destroyed."—having been over Constantinople 30 minutes altogether.

"By this time considerable alarm seems to have been caused in Constantinople, and guns, which had not been previously fired, were now diretced upon the aeroplane. In fact, the flight back down the Sea of Marmora, when Lieut. McClellan took charge, was accompanied by a fusillade of shrapnel and explosive shells, and on arrival at the base it was found that no fewer than twenty-six bullets had penetrated the machine. One lucky shot partially disabled part of the oiling system of one engine, and the return flight was carried out with the second engine alone.

Mr. Basil Johnson, of Rolls-Royce, Ltd., followed with a few points concerning the Rolls-Royce aerial engines, and said that when the war started Mr. Royce struck out on a line of his own, to produce a motor of considerably greater power, as he believed the Rolls-Royce factory could produce an air motor of this high power, which would be sufficiently light to be used in an aeroplane. He set to work, forthwith, and produced the 12-cylinder Rolls-Royce engine which gives over 350 h.p., and the feat they were there to



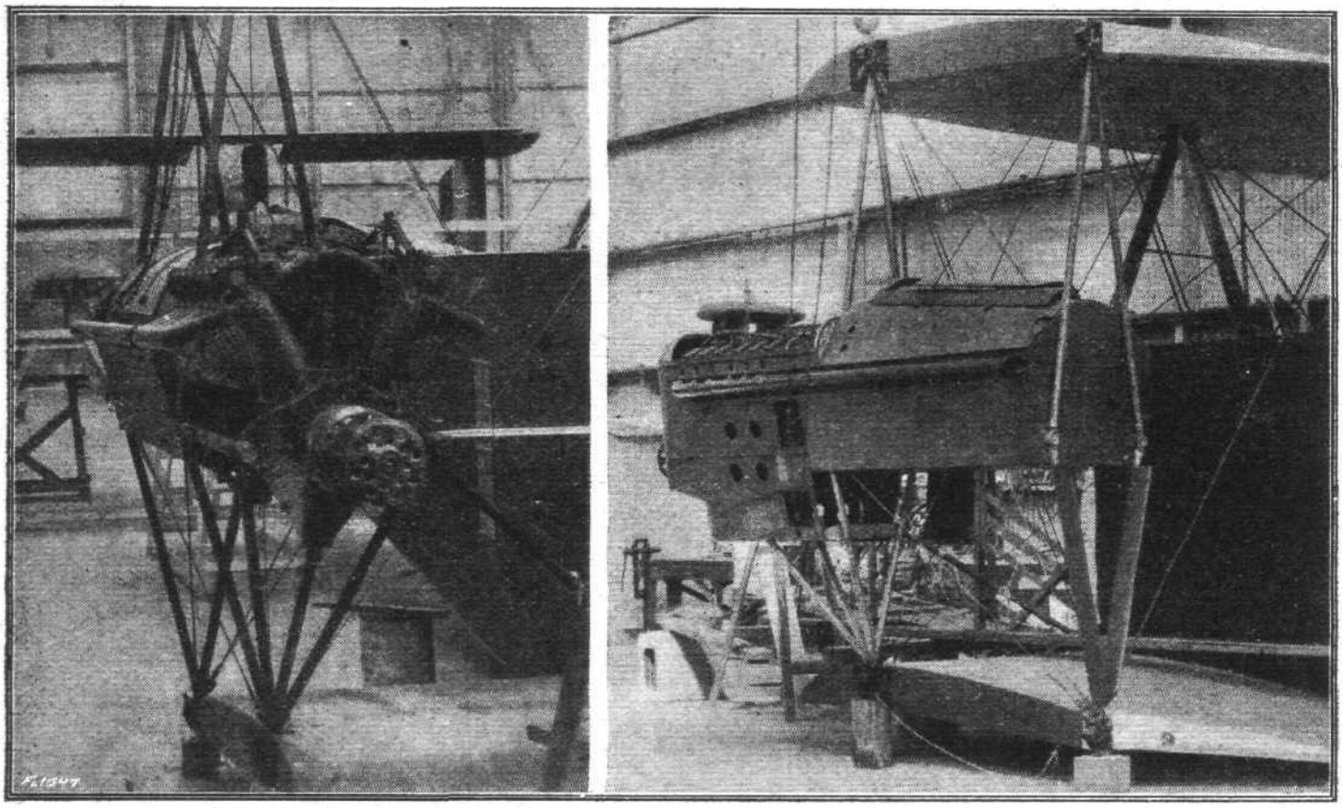
GETTING READY.—A Handley Page biplane of a type similar to that which made the magnificent flight from London to Constantinople. A good idea of the dimensions of the machine is provided by comparison with the people in front.

celebrate that day was only made possible by this foresight. Even Mr. Royce could, however, hardly foresee that within about two years two of these great engines would be used in one plane to carry three men and quantities of bombs, over mountains and seas, from London to Constantinople.

Continuing, Mr. Johnson said that he had been informed by Mr. Handley-Page that so far as his battle-planes were concerned, his records showed that when fitted with Rolls-Royce engines they give better results in climbing, speed, &c., than when fitted with any other make of engine. He wished specially to emphasise this, as owing to a statement made in an American aeronautical paper—which was copied into a few papers here—there had been some misapprehension on this point. He had since heard officially from the Air Board that their conjectures as to the statement being unauthentic were correct, and that the figures were unauthorised. He had only just been informed and he was further now able to divulge for the first time still further successes for the Rolls-Royce engine. It was doubtless clear that these huge weight-carrying, long-distance battle-planes were not designed to compete in speed with the very light and fast fighting machines. In fact, a smaller plane, with a motor of somewhat less power, might be used if speed only were required.

He had received authentic information, that an aeroplane, fitted with a 12-cylinder Rolls-Royce engine, has just broken all world's records for rapid climbing and speed in the air, at a high altitude.

Some photographs of the machine, and the working of the Rolls-Royce engine upon the screen were seen with great interest.



TWO VIEWS OF THE ROLLS-ROYCE ENGINES WHICH MADE THE FLIGHT POSSIBLE.—On the left, a front view of an R.R. installed in the wings of the Handley-Page. The engine housing has been removed to give a better view of the engine. On the right, a three-quarter rear view of the Rolls-Royce engine. In the space behind the engine the petrol tank is carried.

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QUESTIONS IN PARLIAMENT.

Air Force Landing Grounds.

MR. R. GWYNNE on December 12th asked the Prime Minister whether he is aware that the War Office are taking over land for landing grounds for aeroplanes which is already sown with wheat; and if, in view of the shortage of cereals, he will take steps to see that this waste is discontinued?

Mr. Macpherson: The necessity of avoiding taking lands under crop for military purposes is fully appreciated, but sometimes it is impossible to avoid it. I am not aware of what locality my hon. friend has in mind, and if he will give me particulars I will have enquiry made.

Mr. Gwynne: Will the hon. gentleman see that land sown with wheat is not taken until the local agricultural committee has been consulted?

Mr. Macpherson: Yes. I believe that under the new arrangement the agricultural committee is consulted. I know that this particular question was the subject of discussion by the War Office authorities.

Mr. Billing: Is the hon. gentleman aware that vast tracts of land have been taken over and then discarded, and will he see that this does not occur again?

Mr. Macpherson: I think I can assure the House that that will not occur again.

Aircraft Precision Tools.

IN the House of Lords on December 11th Lord Tenterden asked the Government and the Air Ministry to afford greater facilities for the construction of small tools of precision indispensable to aircraft; and inquired if the Minister for Air had decided who were to be the members of the Air Council. He also asked whether the Government contemplated taking control of the whole output of precision tools, and the effect of such a measure on the output of aircraft, and inquired into the conditions of the small tool trade generally, and the present position of the machine tool trade.

The Marquess of Crewe said the position of the machine tool ndustry was one of extreme importance to the country. Many people had fallen into the habit when dealing with trade rivalry of speaking as though Germany were the only country concerned. But in this matter the fact that the machine tool trade was so dormant in this country in comparison with America was due to the greater activity which for many years had been exercised in the United States. All the best machine tools now at work had come from America, and most grateful we were to our American cousins for providing them. Now that they were in the war themselves, however, the supply might not be kept up. There was no subject in which the play of individual minds—the tendency towards particular small improvements, sometimes almost daily and weekly carried out—was more prominent than it was in the business of machine tool making and using. Therefore he hoped that any Government control that it was intended to apply would not in any way interfere with enterprise and invention either of firms or of individuals.

Lord Elphinstone said he had been asked to reply to the question, as it really affected the Ministry of Munitions to a very much greater extent than it did the Air Ministry. The facts of the situation were that the whole output of small tools was dealt with and had been dealt with by the Ministry of Munitions alone, a section of the machine tool department of the Ministry having been set up by that department some time ago. It was the intention of that secton to increase supplies and to accelerate deliveries and to generally control the distribution of small tools required by the Aeronautical and other Government Departments. Every possibly facility was now being given for the construction of small tools, and he assured their lordships that the Ministry of Munitions were fully alive to the importance of the question of increasing the output from every possible available source. Before affording financial assistance for providing machine tools they were bound to satisfy themselves that there was at any rate reasonable prospect that that assistance would be made use of to the fullest extent, and also that the maximum advantages would be got out of such financial assistance. The Government had had control of the supply of tools for a period of two years. The position of the small tool trade was considered to be satisfactory. The output had increased very largely since 1915 and all the demands, so far as they could be foreseen, could be dealt with. The machine tool trade was in exactly the same position. The output had increased to an enormous extent since the beginning of the war. Everything was being done to increase the dilution of labour so that skilled men employed in the trade could be utilised to the best advantage.

The Air Council.

Lord Rothermere replied to the inquiry if he had decided, as Minister for Air, who were to be the members of the Air Council. He said that he could only inform the noble Lord that an Order in Council under the Air Force Act would be issued at a very early date. This would define the constitution of the Air Council and provide for representatives of the Ministry of Munitions to be associated with the Council.

FLIGHT
A Aircraft Engineer

Casualties.

Lieutenant J. M. ATKINSON, Army Service Corps, attached R.F.C., previously reported missing, and now reported prisoner of war in the hands of the Germans, was a pupil at Campbell College, Belfast, from 1908 to 1914. He then obtained a commission in the A.S.C., transferring during the present year to the Flying Corps. Lieutenant Atkinson is a son of Rev. A. H. C. Atkinson, Kilrush Rectory, Ferris, County Wexford.

News has been received that Flight Lieutenant NORMAN BLACK, who was officially reported missing on October 11th, succumbed to wounds on the following day. He was educated at Christ's Hospital, where he was captain of the school.

Second Lieutenant CHARLES BRUCE CAMPBELL, R.F.C., who was killed in action on November 29th, aged 27, was the eldest son of Frederick Campbell, Esq., of Cooinbil, Carrathool, N.S.W.

Second Lieutenant GEORGE ADRIAN CAWSON, Royal Flying Corps, who was killed in action on November 30th, aged 18 years, was the youngest son of George Cawson, Esq., Glanywern Lodge, Farquhar Road, Upper Norwood.

Second Lieutenant S. STUART HENRY, R.F.C., previously reported missing, is stated by the Red Cross Society to be a prisoner of war in Germany. The young officer, who is in his 20th year, is son of Mr. Samuel R. Henry, chairman of Portstewart Urban Council.

Second Lieutenant J. S. HOLROYDE, East Yorkshire Regiment, who has just been officially reported killed, having been reported missing since May 10th, was the only child of Mr. and Mrs. Holroyde, of Bromley, Kent. He was educated at Tonbridge and Dulwich, and at the beginning of the war, at the age of 16, he joined the Kent Motor Cyclists, and transferred to the London Scottish. Later, he entered Sandhurst, and obtained a commission in the East Yorkshire Regiment, being attached to the R.F.C. He went to the front last March. On May 10th, in the words of his squadron commander, "He was out with five other machines on a long-distance reconnaissance. They had to fight their way out and back. Just as they turned to come back the machine in which your son was, was hit by one of the hostile machines. It fell out of the formation, and was seen diving steeply with smoke issuing from it. A German machine dived down on it, and your son opened fire and shot it down. Both machines were seen to crash almost in the same field. It shows wonderful coolness on your son's part. He knew a considerable amount about flying, and must have realized that there was very little chance of their reaching the ground before the machine broke up, and yet he was able to shoot accurately and to bring down his opponent."

Lieutenant RALPH CONWAY JENKINS, R.F.C., entered the Army on the outbreak of war, at the age of 18, in the Garrison Artillery, afterwards being transferred to the Anti-Aircraft Defence. After a time he was offered the post of despatch rider at Harwich and Felixstowe. From there he went to the front and saw active service for twelve months, the latter four months as aerial observer, with a commission as second lieutenant in the R.F.C. He then returned to England, and, gaining his wings at Gosport, was made an instructor. He was a brother of Brigadier-General Conway Jenkins, R.F.C.

Lieutenant DONALD A. D. I. MACGREGOR, R.F.C., who was killed in action on November 30th, aged 22, was the elder son of the late John Macgregor, Leith, and ward of Donald Ross (G. Ricordi and Co.), Balnagowan, Finchley Road, Golder's Green, N.W.

Lieut. CLAUDE WILLIAM MICHELIN NOSWORTHY, R.F.A., attd. R.F.C., who died on December 6th of wounds received in an air combat on the same day, was the third son of Mr. and Mrs. Richard Nosworthy, of Jamaica. He was aged 22.

Flight Lieutenant WILLSON KENWICK NUNNERLEY, R.F.C. (killed in aerial combat on December 5th), was youngest son of Mr. and Mrs. William Nunnerley, of Kenwick, Ellesmere, Shropshire. He was 19 years of age, and received his "wings" in August last.

Lieutenant (acting Captain) HUME BUCKLEY RODERICK, Welsh Guards (killed in action on December 1st), was eldest son of the late William Buckley Roderick and of Mrs. Buckley Roderick, of Goodig, Pembrey, Carmarthenshire, and was 30 years of age. He was promoted in September, 1916, and was appointed acting captain last June.

Captain BASS DURANT CAPPER, R.F.C., who died on Thursday, 6th inst., at Combe Lodge Hospital, Great Warley, Essex, from injuries received in flying, was the second son of Mr. Bass Capper, of Lennoxvale, Belfast.

Flight Commander P. C. D. DOUGLASS, R.N.A.S., B.A.S., who died on active service as the result of injuries received in an aeroplane accident, was the elder son of the late Mr. W. F. Douglass, C.E., and Mrs. Douglass, of 4, Ladbroke Terrace, W. His age was 31.

Captain RICHARD HENRY PROBYN MIERS, R.F.C., late Temporary Major, Glamorgan Yeomanry, J.P., who was killed on December 12th, while flying in England, was the eldest son of Mr. and Mrs. Henry Miers, of Ynispenllwch, Glamorganshire, and 90, Philbeach Gardens, S.W.

Married.

On November 28th, at Kirby-le-Soken, Essex, Captain WYNNARD ANTHONY, R.F.C., only child of Mr. and Mrs. Alfred Anthony, of Colchester, was married to ROSAMUND ANGHARAD KATHLEEN, fourth daughter of Mr. and Mrs. LLEWELYN LLOYD, of Kirby-le-Soken.

On December, 9th 1917, at Roundhay Congregational Church, by special licence, Flight Commander NORMAN W. G. BLACKBURN, R.N.A.S., third son of the late Mr. George W. Blackburn, of Harman Villa, Seacroft, near Leeds, and Mrs. Blackburn, of "Gledhow Lodge," Gledhow Wood Road, Leeds, was married to ANNIE HAIGH, only child of Mr. and Mrs. A. Mitchell Haigh, "Fairlea," The Drive, Roundhay, Leeds. The Rev. Ernest Jenkins, M.A., officiated.

On December 8th, at St. John's Church, Brooklands, Flight Sub-Lieutenant WILLIAM EDWARD CLARKE, R.N., eldest son of Mr. and Mrs. T. E. Clarke, of Harwood Lodge, Bolton, and Challan Hall, Silverdale, was married to EDITH ISOBEL CONGREVE (KATE), second daughter of the late Colonel F. R. SANDYS (late 4th King's Own Royal Regiment), and of Mrs. Sandys, of Raglan House, Brooklands, Cheshire.

To be Married.

An engagement is announced between Second Lieutenant FRANK VENNING BRYANT, R.F.C., second son of Mr. and Mrs. Edmund Bryant, of East London, South Africa, and WINIFRED MARY, only daughter of Mr. and Mrs. J. Jameson TRURAN, of Harrow-on-the-Hill.

The marriage between Captain W. D. BUDGEN, Leinster Regiment, attached R.F.C., and EVELYN BRIDGETT, youngest daughter of the late R. N. HEANE and Mrs. HEANE, of Newport, Salop, took place at St. Nicolas Church, Newport, on December 19th.

Items.

The will of Second Lieutenant NORMAN BUTTERWORTH, Manchester Regiment, attd. R.F.C., of Park Riding, Holmfirth, Yorks, who died of wounds on May 9th, has been proved at £6,454.

German Aerial Activity.

WRITING on December 11th from the War Correspondents' Headquarters in France, Mr. Philip Gibbs says that the enemy is also displaying great aerial activity, and yesterday hostile squadrons of aircraft came out in reconnaissance over our lines at various points between Cherisy, at the extreme left wing of our last operations, and Hargicourt, on the right wing. Reconnaissance seemed their chief aim, but some of these German aeroplanes dropped bombs over our own camps before being chased back by our own squadrons, and in some cases destroyed. Our fighting planes have gone in great numbers over the enemy's territory, bombing his assembly places, dumps, depôts, and field works.

The British Air Services

"PER ARDUA AD ASTRA"

UNDER this heading are published each week the official announcements of appointments and promotions affecting the Royal Naval Air Service and the Royal Flying Corps (Military Wing) and Central Flying School. These notices are not duplicated. By way of instance, when an appointment to the Royal Naval Air Service is announced by the Admiralty it is published forthwith, but subsequently, when it appears in the LONDON GAZETTE, *it is not repeated in this column.*

Royal Naval Air Service.

Admiralty, December 11th.

Probationary Flight Officer (Temporary).—G. B. Treadwell, entered as prob. Observer Officer (Temp.), with origianl seniority of Sept. 16th.

Observer Lieutenant (Temporary) (late Lieutenant, Temporary, R.N.V.R.).—W. C. A. Meade, temp. commission as Lieut. (R.N.V.R.) re-issued with original seniority of Oct. 11th, 1914.

Warrant Officer (Temporary), 2nd Grade.—T. Martin, granted temp. commission as Lieut. (R.N.V.R.), seniority Dec. 6th.

The following have been entered as Prob. Flight Officers (temp.):—W. E. Bryan, H. G. Thompson, H. J. Welch, J. M. Johnston, F. L. M. Harris, E. G. Frost, D. C. Prodger, W. N. Shuttleworth, A. C. Baker, D. Littlejohn, J. A. Munn, F. W. Dolman, and A. Holden.

Temp. commissions as Lieut. (R.N.V.R.) have been granted to the following, seniority as stated:—E. G. Batt, Dec. 6th. C. W. Stamper; Dec. 17th, and J. A. Gye, Dec. 19th.

Admiralty, December 12th.

Flight Sub-Lieutenants (Temporary).—N. Grabowsky and G. L. Lowis, promoted to Flight-Lieuts. (Temp.), seniority Nov. 15th.

Warrant Officers, 2nd Grade (Temporary).—H. T. Foxen, promoted to Lieut., R.N.V.R. (temp.), seniority Dec. 9th; and C. W. Harrison, transferred to permanent list; Dec. 9th.

Probationary Flight Sub-Lieutenants.—S. E. G. Lees (Temp.), and N. C. Watt, granted temp. commission as Sub-Lieuts. (R.N.V.R.), seniority respectively Sept. 13th and Dec. 11th.

Sub-Lieutenant, R.N.V.R. (Temporary).—A. P. Taylor, entered as Prob. Flight Officer (temp.), seniority Dec. 17th.

Late Sub-Lieutenant, R.N.V.R. (Temporary).—G. W. Robinson, temp. commission as Sub-Lieut. (R.N.V.R.) reissued with original seniority of Feb. 5th, 1915.

M. B. Egan promoted to Act. Wt. Officer, 2nd Grade (temp.), seniority Dec. 9th.

Admiralty, December 13th.

The following have been entered as Prob. Flight Officers (temp.):—C. G. J. Whiteside, R. J. Brown, J. W. Wright, J. S. Ralph, and F. F. Smith.

A. G. Bishop and M. E. Moore, both entered as Prob. Observer Officers temp.).

Warrant Officer II. (Temporary).—C. J. W. Hatcher, promoted to rank of Flight Sub-Lieut. (permanent), seniority Sept. 7th.

Lieutenant (R.N.V.R. Temporary).—G. Hazelton, promoted to rank of Lieut.-Comdr. (R.N.V.R. Temp.), seniority Dec. 10th.

The following have been granted temp. commissions as Sub-Lieut. (R.N.V.R. Temp.).—E. G. MacIntyre, J. D. P. Sowerby, and J. R. Bamford (Wt. Telegr. R.N.R., Temp.).

J. Hibbert and H. H. Mitchell have been granted temp. commissions as Lieut. and Sub-Lieut., seniority respectively Dec. 12th and 29th.

Admiralty, December 14th.

Lieutenant-Commander, R.N.V.R. (Temporary).—W. F. Vernon, entered as Squadron Comdr. (temp.), seniority Dec. 10th.

Admiralty, December 16th.

Sub-Lieutenant, R.N.V.R. (Temporary).—J. Pegg, promoted to Lieut. (temp.), seniority Dec. 13th.

Mr. F. Miller entered as Wt. Officer, 2nd Grade, seniority Dec. 12th.

Royal Flying Corps (Military Wing).

London Gazette Supplement, December 11th.

The following appointments are made:—

Staff Officer, 3rd Class (graded as a Staff Captain).—Lieut. V. Buxton, Leic. R., from a Flying Officer (Ob.), and to be Temp. Capt. whilst so employed, vice Capt. B. G. M. F. Nixon, Ind. Inf.; Oct. 2nd.

Flying Officers.—2nd Lieut. J. C. Keyser, Midd'x. R. (T.F.), Sept. 11th. Temp. 2nd Lieut. T. A. Pitt, Gen. List; Sept. 19th. 2nd Lieut. H. E. Wortley, Suff. R., S.R., and to be secd.; Sept. 24th. Temp. 2nd Lieut. L. J. Collier, Ox. and Bucks L.I., and to be transfd. to R.F.C. Gen. List; 2nd Lieut. C. A. Southin, M.C., Lond. R. (T.F.), and to be secd.; Sept. 25th. Capt. B. G. St. John-Smith, N. Staff R., S.R., from R. Welsh Fus.; 2nd Lieut. A. C. Lace, Ches. R., S.R., and to be secd.; Temp. Capt. S. B. Edwards, Manch. R., and to be transfd. to R.F.C. Gen. List; Sept. 27th. Temp. 2nd Lieut. (Temp. Lieut.) H. Hillier, Gen. List, from a Flying Officer (Ob.), seniority from Sept. 15th, 1916. 2nd Lieut. J. L. W. Bacon, Ches. R. (T.F.), and to be secd.; Sept. 28th. Temp. 2nd Lieut. A. C. Guyer, Gen. List; Oct. 8th.

Special Appointment (graded as a Park Commander).—Temp. Lieut. (Temp. Capt.) E. G. Toye, Gen. List, from an Equipment Officer, 1st Cl., and to be Temp. Major whilst so employed; Nov. 16th.

Adjutant.—Capt. B. G. M. F. Nixon, Ind. Inf. from a Staff Officer, 3rd Class graded as a Staff Capt.), vice Capt. W. H. L. O'Neill, Ind. Inf.; Oct. 2nd.

General List.—The notification in the *Gazette* of Oct. 5th, regarding the Officers named, from E. J. Detmold to R. Ferguson, is cancelled; Temp. 2nd Lieut. W. H. Kilbourne, Gen. List to be Temp. Lieut.; Nov. 12th. Temp. 2nd Lieut. G. McDiarmid, M.C., relinquishes his commission on account of ill-health contracted on active service, and is granted the hon. rank of 2nd Lieut.; Dec. 12th. Temp. 2nd Lieuts. resign their commissions:—V. R. Y. St. Leger, K. G. Hill; Dec. 12th. To be Temp. 2nd Lieuts (on prob.):—L. E. Parry; Oct. 10th. M. E. Clubine, H. A. Kelly; Oct. 11th. C. L. Booth, F. G. Crowly, E. Hulme, J. T. C. Lovell, Flight-Sgt. C. Mansfield, from R.F.C.; Nov. 26th. H. Cutler; Nov. 28th.

Supplementary to Regular Corps.—2nd Lieut. H. A. C. Parker is removed from the Army for absence without leave; Aug. 31st.

London Gazette Supplement, December 12th.

The following temporary appointment is made at the War Office:—

Deputy Assistant Director.—Lieut. (Temp. Capt.) L. W. W. Lees, R.G.A., S.R., from an Equipment Officer, 1st Cl., and to retain his temp. rank whilst so employed, vice 2nd Lieut. G. W. A. Brown, R.F.C., S.R.; Oct. 23rd.

The following appointments are made:—

Flying Officers.—Capt. G. B. Syddall, Canadian Exped. Force; Oct. 16th. Capt. J. E. Hallonquist, Canadian Exped. Force; Nov. 2nd. Lieut. O. J. Marchbank, Canadian Engrs.; Nov. 16th. Lieut. H. A. McCormick, Canadian Exped. Force; Nov. 19th. Lieut. A. B. Johnson, Canadian Exped. Force; Nov. 20th. Temp. 2nd Lieuts. (on prob.), Gen. List, and to be confirmed in their rank:—G. A. Leckie; Oct. 6th. H. E. Thomson; Oct. 10th. J. S. Lennox; Oct. 12th. J. L. Horne; Oct. 15th. C. A. Umbers; Oct. 28th. A. A. McD. Arnot; Nov. 3rd. F. McChesney; Nov. 6th. H. G. Mackintosh; Nov. 8th. H. R. Leach; Nov. 15th. R. D. Turnell, A. L. Penning, L. S. Hewett; Nov. 16th. R. V. Garbett, H. W. Ransom; Nov. 17th. H. N. E. Row, M. Helliwell; Nov. 18th. C. J. Clark, J. T. Rymer, R. Neall; Nov. 20th. P. J. W. Reeves, E. S. Osborn; Nov. 21st.

Equipment Officers, 3rd Class.—The initials of Temp. 2nd Lieut. J. A. H. Hood, Gen. List, are as now described, and not as in the *Gazette* of Nov. 13th.

General List.—Sgt. H. G. D. MacF. Payne, from R.F.C., to be Temp. 2nd. Lieut.; Nov. 18th.

Memoranda.—Sgts., from R.F.C., to be 2nd Lieuts. whilst serving with R.F.C.:—C. W. Attwood; Nov. 14th. C. Evans; Nov. 18th.

London Gazette Supplement, December 13th.

Flight Commanders.—Capt. J. L. Head, Lond. R. (T.F.), from a Flying Officer; Nov. 23rd. From Flying Officers, and to be Temp. Capts. while so employed:—Temp. 2nd Lieut. J. H. Tudhope, Gen. List; Nov. 18th. Temp. 2nd Lieut. L. I. Barker, Gen. List; Nov. 21st. Temp. 2nd Lieut. G. E. Thomson, attached K.O. Sco. Bord., and to be transfd. to R.F.C. Gen. List; Nov. 23rd. Temp. 2nd Lieut. A. L. Messenger, Gen. List; Nov. 24th. Lieut. M. W. Turner, R.G.A., (T.F.); Nov. 28th.

Special Appointment (graded as a Flight Commander).—Capt. A. M. Van der Byl, H.A.C. (T.F.), a Balloon Comdr.; Nov. 1st.

Flying Officers.—2nd Lieut. (on prob.) D. O. Robinson, S.R.; Nov. 16th. 2nd Lieut. (on prob.) H. J. W. Roberts, S.R.; Nov. 17th. Temp. Lieut. E. G. Mattingley, attd. Lan. Fus., and to be transfd. to R.F.C., Gen. List; 2nd Lieut. H. L. Storrs, S.R., from a Flying Offir. (Ob.), seniority from Feb. 3rd; Nov. 19th. Temp. 2nd Lieut. J. L. Dunstan, R.A., and to be transfd. to R.F.C. Gen. List; Capt. J. A. Grenier, Can. Exped. Force; Temp. 2nd Lieut. H. Simonis, Gen. List, from a Flying Officer (Ob.), seniority from July 10th, 1916. Temp. 2nd Lieut. M. J. Brebner, Gen. List, from a Flying Officer (Ob.), seniority from Nov. 25th, 1916; Nov. 20th. Temp. 2nd Lieut. F. W. Saunders, M.G. Corps, and to be transfd. to R.F.C. Gen. List; Nov. 21st. 2nd Lieut. (on prob.) W. R. Irwin, S.R.; Temp. Lieut. L. P. Gilliard, A.S.C., and to be transfd. to R.F.C. Gen. List; Temp. 2nd Lieut. E. W. Swann, Gen. List, from a Flying Officer (Ob.), seniority from Dec. 19th, 1916; Nov. 22nd.

Temp. 2nd Lieuts. (on prob.), Gen. List, and to be confirmed in their rank:—J. Worstenholm (since killed in action); July 27th. A. E. Smith; Nov. 8th. W. E. C. Coombs; Nov. 9th. H. J. Richardson; Nov. 15th. R. N. Chandler; Nov. 16th. C. H. Flère, A. W. Winsor, L. J. Mitchell; Nov. 18th. W. Jack, F. H. Watts, A. H. Fraser, D. Cameron, H. Ford, L. G. Prideaux; Nov. 19th. F. R. Waddington, M. H. Goudie, R. J. W. Saubridge; Nov. 20th. M. D. Allen, S. Birch.; Nov. 21st. A. C. Nye, T. J. Donovan, H. C. Tussaud; Nov. 22nd. H. V. C. Luyt; Nov. 23rd.

Flying Officers (Observers).—Capt. W. H. L. O'Neill, Ind. Inf., from an Adjt.; Oct. 2nd, seniority May 20th. 2nd Lieut. (Temp. Lieut.) H. E. Transley, M.C., K.R.R.C. (now a Flying Officer); Jan. 17th to June 8th, seniority from Sept. 14th, 1916.

Balloon Company Commanders (graded as Flight Commanders).—Capt. F. J. F. Lee, R. Muns. Fus., from a Balloon Comdr. (graded as a Balloon Officer); Nov. 22nd. From Balloon Officers, and to be Temp. Capts. whilst so employed:—Lieut. C. H. Gimingham, Herts R. (T.F.) (since killed); July 18th. Temp. Lieut. H. Thrower, Gen. List; Nov. 10th.

Balloon Commander (graded as a Balloon Officer).—2nd Lieut. (Temp. Lieut.) G. H. Gibbs, R.A., from a Balloon Officer, and to be secd.; Nov. 22nd.

Equipment Officers, 1st Class.—2nd Lieut. (Temp. Lieut.) M. Keegan, R. Dub. Fus., from the 2nd Cl., and to be Temp. Capt. whilst so employed; Nov. 22nd.

2nd Class.—From 3rd Cl., and to be Temp. Lieuts. whilst so employed:—Temp. 2nd Lieut. A. A. M. Weir, Gen. List; 2nd Lieut. F. E. M. Bussy, S.R.; Oct. 1st. Temp. 2nd Lieut. (on prob.) L. J. Wood, Gen. List, to be confirmed in his rank, and to be Temp. Lieut. whilst so employed; Nov. 22nd.

3rd Class.—Temp. Lieut. A. R. Rouse, R. Berks, R., and to be transfd. to R.F.C. Gen. List; Oct. 1st. Temp. 2nd Lieuts. (on prob.), Gen. List, and to be confirmed in their rank:—A. Gaze; Sept. 11th. H. Woffenden; Nov. 21st. Sir H. G. de Bathe, Bt.; Nov. 22nd.

Chief Experimental Officers (graded as Park Commanders).—From Experimental Officers, 1st Cl. (graded as Equipment Officers, 1st Cl.), and to be Temp. Majors whilst so employed:—Lieut. (Temp. Capt.) B. M. Jones, R.E. (T.F.), Capt. H. R. Raikes, E. Kent R., S.R.; Nov. 1st. Temp. Capt. H. T. Tizard, Gen. List; Nov. 4th.

Experimental Officers, 1st Class (graded as Equipment Officers, 1st Class).—From Experimental Officers, 2nd Cl. (graded as Equipment Officers, 2nd Cl.)—2nd Lieut. (Temp. Lieut.) C. E. Fairburn, S.R., 2nd to be Temp. Capt. whilst so employed; Oct. 13th. Capt. F. W. Musson, N. Lan. R. (T.F.); Lieut. F. A. Harver, S.R., and to be Temp. Capt. whilst so employed; Nov. 1st.

2nd Class (graded as Equipment Officers, 2nd Class).—From Experimenta Officers, 3rd Cl. (graded as Equipment Officers, 3rd Cl.):—Lieut. J. C. Wallace M.C., R.E., S.R.; Temp. Lieut. J. H. Mackie, Gen. List; Lieut. G. McKerrow S.R.; Oct. 13th. 2nd Lieut. W. E. G. Sillick, S.R., from an Equipment Officer, 3rd Cl., and to be Temp. Lieut. whilst so employed; Nov. 1st.

Central Flying School—Instructor.—Capt. (Temp. Major) C. M. Crowe, M.C., S.R., a Squadron Commander, vice Lieut. (Temp. Major) R. Balcombe-Brown, M.C., R.F.A., S.R., and to retain his temp rank whilst so employed; Oct. 26th.

General List.—Temp. 2nd Lieut. F. P. Clapperton resigns his commission; Dec. 14th. Temp. 2nd Lieut. J. D'A. Steele resigns his commission on transfer to R. Mar.; Dec. 14th. Cadets to be Temp. 2nd Lieuts. (on prob.):—P. W. Abernethy, T. W. Barlow, H. C. Belore, B. J. Bevan, F. Bower, F. G. Brown, T. W. Brockley, G. A. Cameron, R. H. Curtis, G. E. Davies, W. P. Doyle, S. G. Dyson, G. W. Elias, A. E. Evans, E. Fearnside, T. D. Fitsimon, J. Glover, B. Hall, J. Harrison, L. Harrison, E. Hattemore, L. U. Henderson, W. R. Henderson, H. Howes, W. G. Hurrell, E. B. Hyde, C. F. Jackson, L. E. Jones, S. Jones, J. Levy, W. Lockwood, G. E. Mann, W. S. Marshall, G. E. McKenzie, J. W. Mettam, R. Miller, G. F. Moseley, D. H. Murray, J. Napier, H. L. Page, G. Paterson, W. G. Peacock-Dyson, F. H. Perry, H. Pullan, H. C. J. Routledge, J. B. Sanders, A. T. Sprangle, D. Stewart, V. Sveinson; Nov. 28th. J. Baird, R. Cookson, J. A. Freeman, C. A. C. Fullerton, J. W. Hogan, R. Niven, H. S. Sandiford, F. Seddon, C. T. Smith, A. R. Thompson, E. R. Wallington, W. F. Woodland; Nov. 30th. J. Aitken, B. S. Allen, J. Appleby, W. A. Armstrong, F. T. Arnold, L. A. Arnold, C. H. Atkinson, D. S. Atkinson, J. H. D. M. Baldock, W. E. Bardgett, J. A. Beesley, J. R. Belton, R. Bennett, B. A. Bent, H. M. Bickle, G. S. Bourner, C. R. Boyd, A. S. Bradburn, F. W. B. Bradshaw, R. Bramwell, E. G. Brant, C. H. Bridge, A. H. Bristow, R. J. Brotherton, P. L. Brown, R. Brown, H. C. B. Brudenell, J. Burness, F. D. Butcher, J. H. Cartwright, G. W. G. Cass, J. A. L. Champneys, L. S. Clarke, G. D. Coates, J. Cockburn, A

Colley, W. J. Cooper, E. H. Coote, A. J. F. Critchel, A. J. Crook, C. D. Darlington, H. G. Daulton, J. D. Davidson, F. Davidson, L. G. Destrube, A. T. Dickinson, C. W. Dicks, W. L. Dougan, D. C. Dunlop, J. A. Edge, A. L. E. Edwards, A. J. P. Evans, A. W. R. Evans, G. E. Ffrench, S. Fine, F. G. Forshaw, C. E. Francis, R. C. Freemantle, E. Frost, G. W. Gant, J. H. Gardner, J. W. Gibson, C. R. Gooding, J. D. Grant, B. Green, J. Haigh, A. Haines, J. G. Hall, R. D. Hambrook, C. R. Hames, K. D. Handel, H. N. Hastie, W. D. Howie, E. McN. Hapburn, C. J. S. Hesketh, H. B. Hewat, R. M. Hillman, A. Hindley, H. Hitchen, H. Hogdson, A. A. Hoffman, F. Horsley, C. R. R. Horton, W. Howarth, C. H. Howett, H. R. Hughes, E. P. J. Hull, H. T. Hunter, A. P. Jones, H. F. Jones, R. A. D. Jones, T. Jowett, H. E. King, T. W. Kneale, T. J. Knight, W. Knight, C. R. Knott, F. K. Laver, C. R. Lee, V. W. V. Lowrie, G. C. Lugg, T. McCarthy, J. R. McCormack, H. C. McCreary, L. S. McCullagh, G. W. MacDougall, A. N. MacIntosh, A. T. McKay, R. F. McQuarrie, F. J. Madden, A. H. Maltby, C. Marriott, A. C. Masters, J. W. F. Merer, A. R. Meterlerkamp, D. Miller, F. B. Miserov, S. F. Morice, R. C. Morrison, M. F. Mousley, G. A. Munro, H. Naylor, F. Noble, J. R. Noble, E. A. North, R. P. Nowell, J. Olorenshaw, W. H. Ottewell, T. C. Owen, D. A. Parker, G. Pattinson, A. W. Pausch, R. A. Pearce, D. M. Pinkerton, G. P. Prescott, C. F. Putwaine, J. H. G. Pycroft, J. G. Renshaw, R. Ridyard, C. E. Robinson, W. H. C. Robson, R. C. Rogers, W. A. Rollason, A. E. Ross, C. W. Russell, N. Saville, C. H. Sawyer, H. L. Sellar, H. J. C. Seymour, W. J. Sivewright, F. Shaw, T. MacM. Shields, R. P. Smillie, H. J. Smith, E. H. Sparshott, P. A. Stallard, E. Stanton, F. J. Stevenson, A. F. Stokes, W. Strank, C. W. Sutcliffe, H. L. Sutton, D. W. J. Swainston, J. S. Tarbolton, J. S. G. Tassie, G. E. Taylor, J. Taylor, P. S. Tennant, E. H. Thistlethwaite, R. B. Thompson, W. A. Thompson, C. F. H. Thriscutt, C. G. Tidswell, W. Todd, R. C. Townshend, E. R. Tremlett, R. Trueman, A. Tulloch, H. C. Turner, H. B. Twissell, J. C. Uhlman, H. E. Varley, J. Vokey, A. N. Voss, H. H. Wake, D. L. Walker, G. A. Walker, H. W. Walker, J. E. Walker, H. V. Wallace, F. Wallis, J. G. Walton, J. H. Walton, W. A. Warwick, J. W. Wathes, H. Wensley, W. A. Wheeler, R. I. Whetman, O. H. White, E. J. Whitehead, J. H. W. Wilcox, F. E. Wilford, A. Wilkinson, E. R. Williams, R. Williams, J. M. Wilson, J. H. V. Wood, S. H. Wood, J. A. Wrighton, H. T. Yearley, F. J. Young; Dec. 6th. Lieut. H. P. Maybury, Midd'x. R. (T.F.), to be Temp. Capt. (with pay and allowances as Lieut.) whilst holding the appointment of Adjt.; May 4th.

London Gazette Supplement, December 14th.

The following temporary appointment is made at the War Office :—

Staff Lieutenants.—2nd Lieut. (Temp. Lieut.) T. A. Peddell, R.F.C., S.R., from an Equipment Officer, 2nd Cl., vice Capt. E. S. Skipper, R.F.C., S.R.; Nov. 3rd.

Military Wing.—The following appointments are made :—

Staff Officer, 1st Class (graded as an A.A.G.)—Lieut. (Temp. Lieut.-Col.) M. Spicer, North'n R., from a Depôt Comdr. and to retain his temp. rank while so employed, vice Capt. (Temp. Lieut.-Col.) C. F. Lee, Yeo. (T.F.); Nov. 17th.

Squadron Commander.—Capt. W. A. S. Rough, Bedf. R., S.R., from a Flight Comdr., and to be Temp. Major while so employed; Aug. 24th.

Flight Commanders.—From Flying Officers, and to be Temp. Capts. whilst so employed :—Lieut. G. Barrett, S.R.; 2nd Lieut. (Temp. Lieut.) F. D. Holder, M.C., E. Kent R.; Oct. 13th.

Flying Officers.—Lieut. J. R. MacMillan, Can. Inf.; Nov. 8th. Lieut. M. K. Parlee, Can. Exped. Force, from a Flying Officer (Ob.); seniority Nov. 6th, 1916; Lieut. A. D. MacDonald, Can. Engrs.; Lieut. J. W. Richards, Can. Exped. Force; Lieut. A. J. Allen, L'pool. R. (T.F.), from a Flying Officer (Ob.), seniority Jan. 1st. 2nd Lieut. E. W. Guest, R. Lanc. R., and to be secd.; Nov. 15th. Lieut. W. Ridley, Can. Engrs.; 2nd Lieut. S. A. Gomez, Dorset R., S.R., and to be secd.; 2nd Lieut. A. B. Whaley, R.F.A., S.R.; 2nd Lieut. W. F. Jelffs, Lond. R. (T.F.), and to be secd.; 2nd Lieut. K. M. Harris, Suff. R., and to be secd.; Temp. Lieut. C. H. Sands, Notts and Derby R., from a Flying Officer (Ob.), seniority from March 11th. Temp. 2nd Lieut. J. Weaver, attd. Rif. Brig., and to be transfd. to R.F.C., Gen. List; Nov. 16th. Temp. Lieut. G. E. Marden, M.C., Essex R., and to be transfd. to R.F.C., Gen. List; Nov. 17th. Lieut. J. R. Ziemen, Canadian Exped. Force; Nov. 18th. Temp. 2nd Lieut. N. A. Ayres, Gen. List, from an Equipment Officer, 3rd Cl.; Capt. W. A. Wolfendale, M.C., R. Lanc. R. (T.F.), and to be secd.; Lieut. H. McL. Ferguson, R.F.A.; S.R., from a Flying Officer (Ob.), seniority from Jan. 10th. 2nd Lieut. (Temp. Lieut.) A. Clarke, Suff. R., S.R., from a Flying Officer (Ob.), seniority from March 8th. 2nd Lieut. E. K. Blenkinsop, Dorset R., and to be secd.; Nov. 22nd. Temp. Lieut. R. F. Browne, Gen. List, from a Flying Officer (Ob.), seniority from April 30th, 1916; Temp. 2nd Lieut. R. S. F. D. Radcliff, attd. Hamps. R., and to be transfd. to R.F.C., Gen. List; 2nd Lieuts. J. Murch, Lond. R. (T.F.), from a Flying Officer (Ob.), seniority from March 22nd, and to be secd.; Lieut. W. E. Lambert, Canadian Exped. Forces; Nov. 23rd. Temp. 2nd Lieut. H. G. Tucker, Gen. List, from a Flying Officer (Ob.); Nov. 24th. seniority from Feb. 3rd. Lieut. C. J. L. Lawrence, Canadian Exped. Force; Nov. 27th. Temp. 2nd Lieuts. (on prob.), Gen. List, and to be confirmed in their rank :—G. F. Peirce; Oct. 27th. J. Wingate; Nov. 4th. G. G. Pasley; Nov. 5th. W. B. Day; Nov. 9th. F. Nash; Nov. 11th. J. R. Falck, B. Martin; Nov. 15th. C. C. A. Norris, J. A. Yates, A. L. Code; Nov. 16th. H. W. Sangway; Nov. 17th. V. U. Downard, F. C. Edwardes; Nov. 18th. W. L. McGregor; Nov. 20th. W. R. W. Burns, G. B. Hett, D. M. Scrimgeour; Nov. 23rd. B. E. Sharwood-Smith; Nov. 24th. O. M. Baldwin; Nov. 25th. H. R. Caffyn, H. L. Whiteside; Nov. 26th. E. P. Crossen; Nov. 27th.

Balloon Wing Commander.—Capt. (Temp. Major) H. M. Meyler, M.C., Bord. R., from a Co. Comdr. (graded as a Sqdn. Comdr.), and to be Temp. Lieut.-Col. while so employed; Nov. 22nd.

Equipment Officers, 1st Class (from the 2nd Class).—Temp. Capt. F. R. Williams, Gen. List; July 1st. And to be Temp. Capts. while so employed :—Lieut. G. J. Monson-Fitzjohn, Bord. R. (T.F.); Aug. 1st. Temp. Lieut. T. Allen, Gen. List; 2nd Lieut. (Temp. Lieut.) G. E. Quincey, S.R.; Sept. 1st. Lieut. H. Phillips, S.R.; Sept. 22nd. Lieut. S. Allenby, S.R.; Sept. 26th. Temp. Lieut. H. F. Bradley, Gen. List; Temp. Lieut. A. B. W. Greenhough, M.C., Gen. List; Nov. 1st. 2nd Cl.—From the 3rd Cl. :—Lieut. E. W. Stubbs, L'pool. R. (T.F.); May 1st. Capt. O. M. Greg. R. War. R. (T.F.); Sept. 1st. Lieut. G. H. C. Crooke-Rogers, Worc. R.; Nov. 1st.

General List.—Temp. 2nd Lieut. V. Riches resigns his commission; Dec. 15th. J. Darwen, late Lieut. Canadian A.S.C., to be Temp. 2nd Lieut.; Oct. 22nd. To be Temp. 2nd Lieuts. (on prob.) :—Sgt. M. W. Doyle, from R.F.C.; Nov. 1st. 2nd Cl. Air Mech. P. F. Barrett, from R.F.C.; Actg. Cpl. A. T. Bebbington, from A.S.C.; Pte. A. W. Brittain, from A.S.C.; Actg. Cpl. A. H. Bull, from R.F.C.; Nov. 13th. J. S. Sutherland; Nov. 23rd.

Memorandum.—1st Cl. Air Mech. R. Kite, from R.F.C., to be Temp. Hon. 2nd Lieut. whilst specially employed; Dec. 15th.

Supplementary to Regular Corps.—Temp. 2nd Lieuts (on prob.) are confirmed in their rank :—H. J. W. Roberts, J. C. Keen-Hargreaves.

London Gazette Supplement, December 16th.

The following appointments are made :—

Special Appointment (graded as a Squadron Commander.—Capt. R. W. Bruce, Canadian Local Forces, from a Co. Comdr. (graded as a Flight Comdr.), and to be Temp. Major whilst so employed; Nov. 1st.

Flying Officers.—Temp. 2nd Lieut. L. Clarke, Gen. List, from a Flying Officer (Ob.); April 12th, seniority from April 6th, 1916 (substituted for notification in *Gazette* of May 2nd). Temp. 2nd Lieut. J. P. de E. Robinson, Welsh R.; Sept. 29th. 2nd Lieut. D. C. S. Thomas, Welsh R., and to be secd., Temp. 2nd Lieut. G. Milner, R.E.; Oct. 1st. 2nd Lieut. M. H. A. Fletcher, R.A., to be secd.; Oct. 3rd. Temp. 2nd Lieut. E. C. Netherton, A.S.C., and to be transfd. to R.F.C., Gen. List; Oct. 12th. Temp. 2nd Lieut. (on prob.) N. L. Desoer, Gen. List, and to be confirmed in his rank; Oct. 31st. Temp. 2nd Lieut. W. L. Coleridge, M.G., Corps, and to be transfd. to R.F.C., Gen. List; 2nd Lieut. M. V. Molony, R.W. Kent R., and to be secd.; Nov. 9th. 2nd Lieut. J. Jacobs, Manch. R. (T.F.), and to be secd.; Nov. 13th. Lieut. D. R. Pattie, Canadian Exped. Force; Nov. 14th. Temp. 2nd Lieuts. (on prob.), Gen. List, and to be confirmed in their rank :—H. A. Wallace, J. B. Saer; Sept. 28th. G. E. Reffell; Oct. 12th. R. N. Iverach, R. J. Thomas; Oct. 31st. E. L. Raworth; Nov. 6th. G. L. Smart; Nov. 9th. W. B. Lane, G. N. McBlain, R. V. Elwood; Nov. 12th. J. Loupinsky, R. Caledcott, E. O. Cudmore; Nov. 13th. W. Stannard; Nov. 14th. A. J. Donaldson, L. H. Raybould, I. A. Romyn, L. R. Lang, D. W. Lees; Nov. 15th. E. Nestmoreland, H. H. Tait, E. H. Johnson; Nov. 18th. R. C. Cain; Nov. 19th. A. L. Aldridge; Nov. 21st. A. H. Herring, J. L. Holt, C. E. G. Cooper; A. H. Harris, A. Coombs, F. J. Fogarty, G. E. Shermur; Nov. 22nd. E. W. Lindeberg, J. O. Barclay, J. C. Young, C. N. Madeley, I. D. Cameron; Nov. 23rd. E. Mather, H. Steed; Nov. 24th.

Flying Officer (Observer).—Temp. 2nd Lieut. A. N. Martyn, Gen. List, from a Flying Officer; Oct. 17th, seniority from Sept. 11th, 1916.

Balloon Officers.—Temp. 2nd Lieut. (on prob.) D. S. Gray, Gen. List; Oct. 19th, seniority from May 30th, without pay prior to Oct. 19th, and to be confirmed in his rank; Lieut. F. W. Avison, Midd'x R., S.R., and to be secd.; 2nd Lieut. G. A. Hunn, Norf. R., S.R., and to be secd.; Nov. 15th. Temp. 2nd Lieuts. (on prob.) Gen. List, and to be confirmed in their rank :—G. D. H. Ross, W. H. G. Lowther; 2nd Lieut. A. Marshall, A.S.C. (T.F.), and to be secd.; 2nd Lieut. N. K. Brooks, R.F.A., S.R.; 2nd Lieut. H. Nuttall, R.F.A., S.R.; Nov. 26th. Temp. Lieut. (acting Lieut.) G. E. B. Pottinger, R.A., and to be transfd. to R.F.C., Gen. List; 2nd Lieut. R. Bayley, A.S.C. (T.F.), and to be secd.; Nov. 27th. Lieut. R. H. Ley, Canadian Exped. Force; Temp. 2nd Lieut. L. W. Baker, R.A., and to be transfd. to R.F.C., Gen. List; 2nd Lieut. A. G. McCorquodale, Arg. and Suth'd. Highrs., S.R.; Nov. 29th.

Adjutants.—Capt. D. C. L. Speed, K.R. Rif. C., from a Balloon Co. Comdr. (graded as a Flight Comdr.); Nov. 1st. Capt. H. R. Kavanagh, R. Ir. Fus., and to be secd.; Nov. 26th. And to be Temp. Capts. (without pay or allowances of that rank) whilst so employed :—2nd Lieut. (Temp. Lieut.) E. Page, Midd'x R., from a Flying Officer; Oct. 21st. Temp. Lieut. W. G. Perkins, R. Fus., and to be transfd. to R.F.C. Gen. List, vice Lieut. (Temp. Capt.) E. Duveen, S.R.; Oct. 30th. 2nd Lieut. (Temp. Lieut.) W. E. G. Bryant, R. Fus., from a Flying Officer (Ob.); Nov. 1st. Lieut. W. McI. Watt, R. Highrs. (T.F.); Temp. 2nd Lieut. G. A. Sinclair-Hill, Gen. List, from a Balloon Officer; Nov. 26th.

Depôt Commander.—Capt. (Temp. Major) H. Lee, S.R., from a Park Comdr., and to be Temp. Lieut.-Col. whilst so employed; Nov. 17th.

Park Commanders.—From Equipment Officers, 1st Cl., and to be Temp. Majors whilst so employed :—Capt. A. M. C. Scott, Lond. R. (T.F.); Oct. 25th. Lieut. (Temp. Capt.) L. Findlater, M.C., Manch. R., S.R.; Nov. 1st. Lieut. (Temp. Capt.) T. W. Winter, S.R.; Nov. 29th.

Equipment Officers 1st Class.—From the 2nd Cl., and to be Temp. Capts. whilst so employed.—Temp. Lieut. A. Chapman, Gen. List; Nov. 16th. Temp. Lieut. H. Fernihough, Gen. List; Nov. 23rd.

2nd Class.—From the 3rd Cl.—Lieut. L. G. P. Warren, S.R.; April 23rd. 2nd Lieut. W. A. Robson, S.R., and to be Temp. Lieut. whilst so employed; June 15th. Lieut. W. H. Trinder, S.R.; Nov. 1st. And to be Temp. Lieuts. whilst so employed : 2nd Lieut. G. A. Lawlor, S.R.; 2nd Lieut. F. C. Thomas, S.R.; Temp. 2nd Lieut. H. Cooke-Smith, Gen. List; 2nd Lieut. R. A. Trelease, S.R.,; 2nd Lieut. E. McR. Cockell, S.R.; Temp. 2nd Lieut. N. A. C. Runnels-Moss, Gen. List; Lieut. E. Cooke, S.R.; Nov. 17th.

Schools of Aerial Gunnery.

Assistant Instructor in Gunnery (graded as an Equipment Officer, 3rd Class).—Lieut. G. R. Spencer, Lan. Fus., S.R.; Oct. 22nd.

General List.—The following, from R.F.C., to be Temp. 2nd Lieuts. (on prob.) : 3rd Cl. Air Mech. J. A. Leonard, 2nd Cl. Air Mech. G. Johnson, 3rd Cl. Air Mech. W. H. P. Parker; Nov. 13th. The following to be Temp. 2nd Lieuts. (on prob.) :—Cpl. W. F. M. Hopkins, from Yeo. (T.F.); Nov. 22nd. F. C. Worton; Nov. 28th.

Aeronautical Inspection Department.

London Gazette Supplement, December 13th.

To be Temp. Hon Lieut. :—F. H. Wheeler, whilst employed as Assist. Inspector A.I.D.; Aug. 1st.

Air Raid Compensation.

IN connection with the new Government scheme of compensation for damage by aircraft and bombardment, the Board of Trade draw attention to the following points :—

The benefit of free compensation up to £500 extends to persons the whole of whose property in the United Kingdom does not exceed £500 in value, and also to persons whose property exceeds that value, provided that, in the latter case, all value in excess of £500 is insured under the Government scheme. Where part only of the excess value is so insured, the free compensation is proportionately reduced. The scheme does not apply to persons the whole of whose property exceeds £500 in value, and who have not insured any part of it under the Government insurance scheme. The term "property" includes not only buildings, but their contents, and any other kind of property usually insured against fire under an ordinary fire policy. It does not include, *e.g.*, land, money, or securities. The scheme takes effect in respect of damage done on or after September, 1917. In no circumstances will a refund of premiums be made in respect of any insurance that may have been effected with the Government.

The address of the Air Raid Compensation Committee is 51, Palmerston House, Old Broad Street, London, E.C. 2.

SIDE-WINDS.

HIS many friends in the industry will extend their sympathy to Mr. Douglas W. Thorburn in the bereavement he has suffered in the sudden death of his father. This has naturally affected the future plans of Mr. Douglas Thorburn, and if any of his friends miss him for the time being from the accustomed haunts, or if he fails to call as usual, they will know the reason.

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METAL small parts for aeroplanes, and in fact anything in the way of small steel stampings, welding, tube-cutting and filing, is the speciality of the Pulvo Engineering Co., Ltd., of 10–16, Dane Street, Holborn, W.C. The firm are utilising a good deal of female labour, and they pride themselves on the way in which their workers are looked after. The result is seen in the cleanliness of the machine shops, which is invariably commented upon by visitors to the works. Another interesting fact is that the ranks of the workers have been recruited from all classes of society.

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CERTAINLY not the least important part of the journey of the Handley Page machine to Constantinople was the lubrication of the Rolls-Royce engines, and it will come as no surprise to know that Wakefield "Castrol" worthily upheld its great reputation. During the present cold snap the fact that castrol maintains its efficiency even in extremely cold weather has been again satisfactorily put to the test.

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"HERMETIC" is a special composition for joints of motor cars, gear boxes, &c., which has been finding great favour in France, and we understand the French air service are extensive users. It takes the place of ceruse, linseed-oil varnishes and other substances, and enables the joint to be made perfectly tight. At the time of use "Hermetic" is a thick liquid, and it is spread by means of a brush over the joint, which it impregnates. When both sides are impregnated, the joint is put in place, and in a few minutes the material is consistent enough to ensure absolute tightness without the use of paper. Messrs. Mestre and Blatge, of 20, Store Street, Tottenham Court Road, W.C., are selling the composition, and they will be pleased to send samples to any firm who would like to try it.

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ORNAMENTAL as well as useful is a little desk mirror to hand from the Cellon Company, Limited, and for which many thanks. Incorporated in the lower part of the mirror is an ingenious calendar, which shows a month at a time, and is instantly changed as the months go by. It is an acquisition to any desk and lucky are those friends of the Cellon Company who are fortunate enough to receive one.

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THE directors and employees of the AG.S. Manufacturing Co., of 4 and 5, Norfolk Street, Strand, W.C.2, have decided to celebrate Xmas this year by making things brighter and happier for others. They have arranged to entertain 500 poor children to tea at Chelsea, and afterwards there will be an entertainment and distribution of toys. They have sent 275 parcels to lonely soldiers of many regiments on the Western Front, and are contributing £50 to Sir Arthur Pearson's Hostel for Blinded Soldiers. It is a splendid idea, and the efforts to bring a little happiness to some at what used to be the "festive season" will be fully appreciated.

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THE considerable increase in the number of H.P. employees was emphasised when the arrangements for the third annual dinner were being made, and in consequence the function, on Saturday last, was held in the Connaught Rooms, the number present being between 1,200 and 1,300. Mr. Handley Page was in the chair, and in responding to the toast of "the old firm," proposed by Mr. R. S. Hubbard, made an earnest appeal to all the employees to "do their damnedest." The whole situation was in the hands of the aircraft workers. Mr. Handley Page paid a tribute to the able way in which Mr. Workman had watched over the H.P. interests on the "other side." Mr. Workman also strongly supported Mr. Handley Page in his appeal for unity among the workers. An excellent concert followed, and needless to say—with Mr. Handley Page in the chair—a very pleasant evening ensued.

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The Work of Italian Aviators.

A SEMI-OFFICIAL statement issued in Rome announces that between October 25th and November 30th Italian aerial squadrons carried out no fewer than 40 large bombarding operations. Altogether 242 Caproni aeroplanes participated in these operations, and dropped a total of 45 tons of bombs and other explosives. Of this large number of aeroplanes only eight failed to return to their bases, and 32 pilots, observers, and machine-gunners were lost. During the same period Italian airships executed 14 bombardments at night, and dropped 14 tons of bombs without suffering any loss.

NEW COMPANIES REGISTERED.

AERO-MOTOR ENGINEERING COMPANY, LTD. Private company. Capital, £10,000, in £1 shares.

BATH AIRCRAFT, LTD.—Capital £20,000, in £1 shares (10,000 participating preference). First directors:—J. E. Henshaw, T. B. Silcock, H. J. Thomas, C. A. Richter, and H. D. Richter.

BIRMINGHAM AIRCRAFT COMPANY, LTD.—7, Waterloo Street, Birmingham.—Capital £100, in £1 shares.

INTERNATIONAL FLYING, LTD.—Capital, £2,500, in 5s. shares. Expert advisers, engineers, exhibitors, &c.

SWIFT AVIATION COMPANY, LTD., 41–3, Richmond Road, Kingston-on-Thames.—Capital £5,000, in £1 shares. Acquiring business of the Swift Aviation Company, carried on at Kingston-on-Thames, manufacturers and dealers in aeroplanes, parts, &c. First directors: J. C. Wilson, C. Smith, and G. Thomas.

BUSINESS NAMES REGISTRATIONS.

CHELSEA WELDING AND ENGINEERING COMPANY.—Registered, November 13th, 1917. Aircraft welders and fitters, 170B, King's Road, Chelsea, S.W.3. Business commenced, November 2nd, 1917. Partners: (1) Frederick Sermon (British), 1, Albert Cottages, Flood Street, Chelsea; (2) Ernest Watts (British), 10, Eustace Road, Fulham, S.W.

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IMPORTS AND EXPORTS, 1916–1917.

AEROPLANES, airships, balloons, and parts thereof (not shown separately before 1910). For 1910 and 1911 figures, see "FLIGHT" for January 25th, 1912; for 1912 and 1913, see "FLIGHT" for January 17th, 1914; for 1914, see "FLIGHT" for January 15th, 1915; for 1915, see "FLIGHT" for January 13th, 1916; and for 1916, see "FLIGHT" for January 11th, 1917.

	Imports.		Exports.		Re-Exportation.	
	1916.	1917.	1916.	1917.	1916.	1917.
	£	£	£	£	£	£
January ...	1,509	10,842	6,399	67,033	Nil.	Nil.
February ...	6,444	9,479	30,693	26,512	—	6
March ...	3,388	11,158	17,872	58,517	7	—
April ...	3,383	21,141	22,608	21,151	3,783	—
May ...	1,986	6,877	26,165	59,713	300	—
June ...	4,986	2,670	50,287	14,647	—	—
July ...	2,072	9,104	12,932	106,250	—	—
August ...	2,583	18,680	13,555	68,315	420	258
September	1,076	9,047	36,048	56,491	—	30
October ...	952	58,086	9,289	73,580	8	100
November	7,406	169,574	12,858	75,632	—	—
	35,785	326,658	238,706	627,841	4,518	394

⁂ ⁂ ⁂ ⁂

Aeronautical Patents Published.

Applied for in 1916.

The numbers in brackets are those under which the specifications will be printed and abridged, &c.

Published December 20th, 1917.

12,970. E. H. CLIFT. Air-speed indicators. (111,308.)

13,481. E. R. CALTHROP. Parachute-launching devices. (111,312.)

Applied for in 1917.

The numbers in brackets are those under which the specifications will be printed and abridged, &c.

Published December 20th, 1917.

265. J. R. PORTER. Aeronautical machines. (111,374.)

3,330. C. A. CHRISTIANSON. Aeroplanes, &c. (111,407.)

10,412. W. M. WRIGHT AND C. L. PASHLEY. Flexible connections, centre wires, &c., for aircraft. (111,446.)

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Flight's
Christmas Greeting.
1917.

By "D. D. D. D."

OUTH WOPPINGTON was plunged in grief—at least the newspapers said so. The Right Hon. Ernest Eggleton Hetherby, who had represented the constituency in Parliament for fifteen years, had died of senile decay and the *South Woppington News* considered that it would be very difficult to fill his place. This view was apparently not shared by at least three gentlemen, who had already come forward as prospective candidates. They were :—

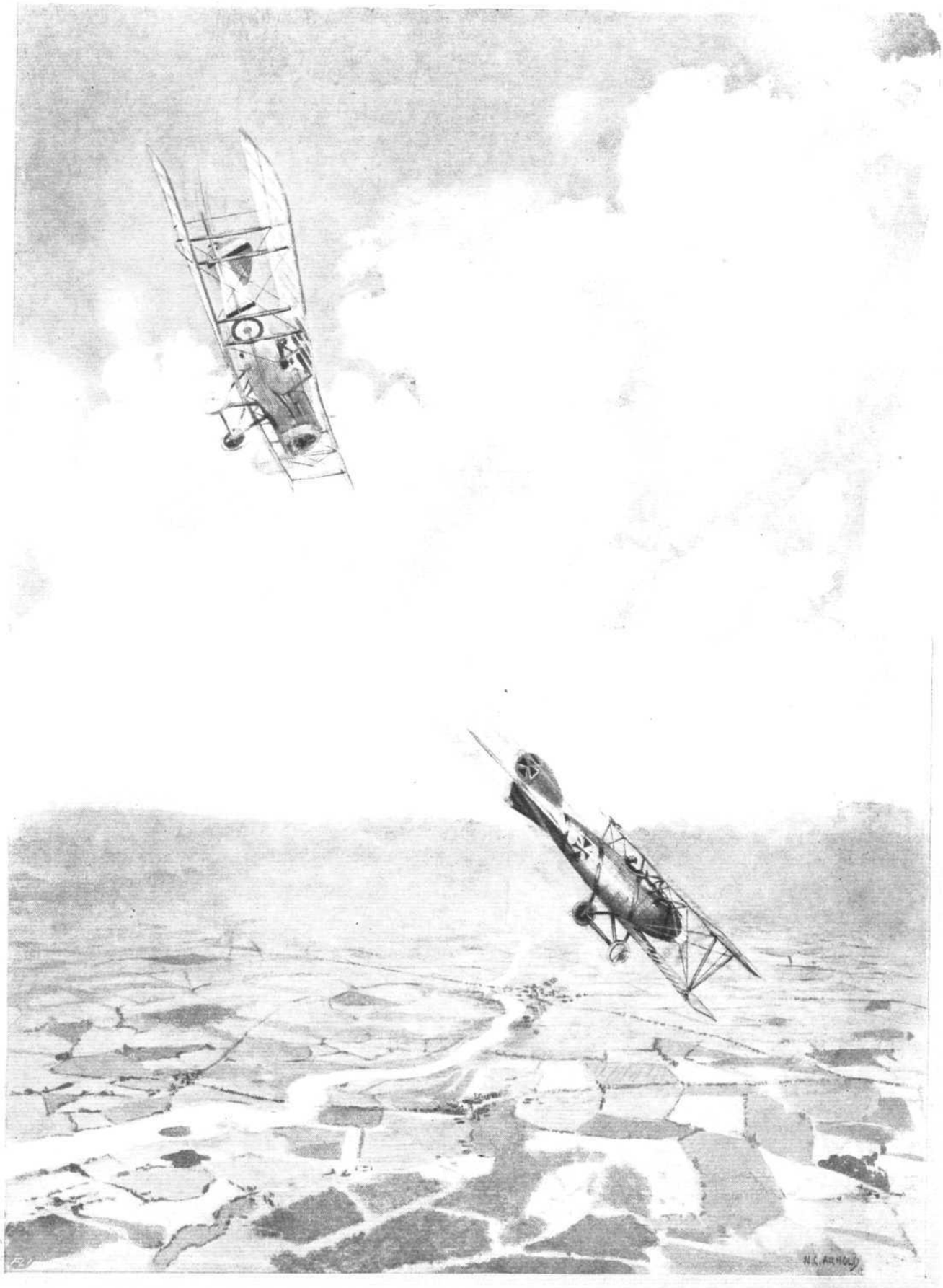
Sir Willington Wanningham (Government).
Mr. Stuart Blythe, K.C. (Independent).
Mr. Arrowby I. Ayres (Watchdog).

It was rumoured in the "Spotted Dog" that a fourth candidate, a local man, was likely to enter the lists, and offer himself to the electors simply and solely as a Reprisalist. But it was felt that the fact of his being a local man would severely handicap him. No man is a prophet in his own country, so Sir Willington Wanningham had come from his palatial mansion in Cumberland, Mr. Stuart Blythe from a garden city, and Mr. Arrowby I. Ayres from no one knew where. The all-important point was that none of them had ever been in South Woppington before and had no conceivable interest in the place. It was really difficult to tell which candidate the *South Woppington News* favoured. It reproduced a photograph of Sir Willington playing ball with his little niece, and in the same issue gave the year in which Mr. Stuart Blythe took silk, and hinted that he might eventually sit on the Woolsack. In that issue Mr. Arrowby I. Ayres appeared to be amongst the "also ran." Knowing well the refined tone of the *South Woppington News*, I suspected that he was in some way *declassé*, and I decided not to vote for him. But I was speedily disillusionised. The very next day the *News* gave a two-column interview with Mr. Arrowby I. Ayres, and headed it "The Man Who Wants to Get Things Done." I decided to vote for him.

This was my frame of mind on going to bed. On rising next morning, I was more determined than ever to vote for him. The censor, I am afraid, will not allow me to tell you exactly what it was that confirmed my decision. Suffice it to say that there was an air raid that night, and that we in South Woppington were not altogether unaware of the fact.

As I shaved that morning I cut myself twice through itching to get things done, and badly jammed the inside of my cheek with the tooth brush through the vehemence of my determination to insist on air reprisals. Long before I had finished dressing I had come to the conclusion that both the white-livered baronet and the glib-tongued barrister ought to be hounded out of the constituency, and I was determined to do some of the hounding.

At midday I bought a halfpenny paper, and found that Woppington loomed large in the news. I turned eagerly to the column headed "Woppington Candidate says Wop German Towns." Ah, I thought, good old Arrowby I. Ayres! But it wasn't. I could hardly believe my eyes—it was Sir Willington Wanningham who had uttered those memorable words. He had said a great many other things which seemed to me truly admirable, such as: "The electors of Woppington in giving me their votes will let these bandits of the air, these moon-



OVER THE LINES: On the tail of an enemy Albatros. *(By N. G. Arnold.)*

ighters, these raiders of the night, know that they will be repaid in kind. I demand a hecatomb in every German town." After all, I reflected, blue blood tells, and evidently Sir Willington was the man for Woppington. His language seemed to me to express admirably my own sentiments. A man of social standing who would talk like that in Parliament would be a real asset to the nation. I decided to vote for him.

But on the fourth page of my halfpenny paper, in a special article on the urgent need of reprisals, Mr. Stuart Blythe, K.C., was quoted as saying that it was simply to secure a policy of reprisals that, at a crisis like the present, he ventured to oppose the Government nominee. The Government had done nothing but temporise. "Was it likely," he asked, "that any nominee of the Government would be a strong man? Was such a creature likely to harass the Government till we got reprisals?" Now, I am not easily swayed in my opinions, but I must own that these arguments shook my faith in Sir Willington. Everything considered, I decided to support Mr. Blythe. He was not a party man, his hands were free, and his legal training would enable him to present the case for reprisals to advantage.

A few days later South Woppington was thrilled to its core. Every paper in England rang with the news. Mr. Arrowby I. Ayres had challenged Sir Willington Wanningham to a twenty round contest to be held at the Palaceum Music Hall, the proceeds to go to a war charity. It happened thus. Sir Willington was addressing an open-air audience from his twin six car, and in the midst of an impassioned period exclaimed, "I am thoroughly conversant with every phase of flying ——" Here he paused, either for effect or for want of breath, whereupon a rude raucous voice said "'E means *lying*." Ribald laughter followed this sally, and Sir Willington roared at the top of his voice, "If the cur who made that observation will step forward I will thrash him like a dog." Nobody stepped forward, though I very nearly got pushed forward. Finally the meeting broke up in disorder.

Next day the report got out that it was Mr. Arrowby I. Ayres who had made the insulting remark. He, however, wrote to the *South Woppington News* to say that he had not done so, but that it was a pretty witticism nevertheless, and that if Sir Willington would say the things he did say, he ought not to be surprised if the men of Woppington told him what they really thought about him. Sir Willington wrote and said that Mr. Arrowby I. Ayres was no gentleman and was simply pandering to the rabble. Mr. Stuart Blythe now took a hand, and in a carefully worded letter pointed out that there is no rabble in South Woppington, and that Sir Willington had no right to come from Cumberland to insult the free-born electors of Woppington; nevertheless, he considered Mr. Arrowby I. Ayres' letter in the worst possible taste—it was altogether unpardonable gratuitously to cast aspersions on the veracity of a fellow candidate. Mr. Arrowby I. Ayres then challenged Sir Willington to fight the matter out in true British style; as for Mr. Stuart Blythe, he said, that person was he believed, a lawyer—and South Woppington knew what lawyers were. This induced Mr. Stuart Blythe to threaten Mr. Arrowby I. Ayres with a libel action, whereupon the latter apologised and said that though lawyers were passable enough in their proper place, that place was certainly not the House of Commons, where their ineptitude was conspicuous from the Treasury Bench to the Kitchen Committee, and he offered to box, run, row, or swim Mr. Stuart Blythe for £100 a side. At this stage it must be admitted, popular sentiment was strongly in favour of Mr. Arrowby I. Ayres, who was spoken of even by his opponents as a "good old sport."

The *South Woppington News*, in a chaste leader, appealed to all three candidates to drop personalities and confine themselves to the mighty issues at stake. Many letters appeared from electors, and many more were unavoidably held over on account of want of space. Two of mine were held over—one, quite a short one, urging the advisability of a more suitable venue for the proposed twenty-round contest than the Palaceum, and the other simply asking if it were true that Mr. Stuart Blythe had insured his voice for £1,000, as I had been informed on eminently credible authority.

Oratory has always had charms for me, and I found myself swayed in turn by the eloquence of all three candidates, who seemed to me to represent three distinct schools of oratory. Demosthenes, I believe, used to orate with pebbles in his mouth; Sir Willington sounded as though he followed this tradition. Mr. Stuart Blythe reproduced the cultured charm of Cicero with a dash of Daniel O'Connell in it, whilst Mr. Arrowby I. Ayres reminded one irresistibly of Robespierre haranguing the Commune, in the attitude of Ajax defying the lightning.

Mr. Arrowby I. Ayres naturally made great capital out of the fact that he had four times been up in an aeroplane, and actually looped the loop. Sir Willington reminded the electors that three of his ancestors had distinguished themselves in the House of Lords. This let Mr. Stuart Blythe in, and in a very telling passage, he exclaimed: "It is obvious that the proper place for such a distinguished flying man as Mr. Arrowby I. Ayres is in the air, driving away Gothas; it is equally obvious that Sir Willington ought to go to the House of Lords, and keep up the family traditions; *my* place is in the House of Commons."

Sir Willington seemed to know a great deal about flying—I mean a great deal for a man who came from such a very old family. He was constantly telling us things like this: "The power exerted by a pigeon flying is 2,222 feet per minute, which works out at approximately 50 horse-power per ton weight." This he said would give us some idea of the horse-power necessary to clear the air, and it was this statement, I imagine, that drew from Mr. Arrowby I. Ayres a decidedly vulgar remark about ass-power, which vulgar remark decided me not to vote for Mr. Ayres. To help us to realise the difficulty of aerial defence, Sir Willington explained that if you allowed only two pigeons to a square yard (surely, he said, a modest demand), a very ordinary-sized flock of pigeons, looking little larger

than a Gotha, would contain 117,183,000 pigeons, and yet this target would give a sportsman no chance whatever. It was stupid, therefore, he said, to say, like Mr. Arrowby I. Ayres, that Gothas ought to be brought down like pheasants driven to the guns.

Mr. Stuart Blythe stole Sir Willington's pigeons, so to speak, to illustrate the food problem. It was, he said a well-known fact that a pigeon eats half a pint of grain a day, and that consequently Sir Willington's flock of pigeons would require some 9,800,000 bushels of grain a day. That perhaps would give them some idea of the magnitude of the problem that men like Sir Willington left untouched.

Mr. Arrowby I. Ayres said that, personally, he would be very pleased to talk about pigeons when the war was over, but at present—no, emphatically no! For his part, he would never sleep peacefully in his bed till he heard Gothas tumbling from the skies like a shower of meteors. He had, he said, challenged both his opponents to fight him—and they had refused. Were these craven-souled wretches the kind of men to represent South Woppington? A thousand times, no! He, Mr. Arrowby I. Ayres, had entered into a £2,000 bond not to accept the Premiership, nor the Chancellorship of the Exchequer, as long as the war lasted. Why did his opponents not do the same? He was, he said, going to Parliament, not to smoke cigars in the lounge of the best club in the world, not to seek office and bolster up his family traditions, not with an eye on the Woolsack, but merely to become the scourge of imbecility, inactivity, inertia, and inanity, and to voice the claims of the toiling masses, if need be, in tones of brass. This speech of his on the eve of the poll gave me furiously to think—there was a good deal in what he said.

* * *

It was a very small poll, the smallest on record, and the figures were declared as follows:—

Sir Willington Wanningham (Government)	2,381
Mr. Stuart Blythe, K.C. (Independent)	503
Mr. Arrowby I. Ayres (Watchdog) ...	84

Mr. Arrowby I. Ayres accounted for his defeat by the fact that a false alarm of an air raid was sent out (possibly by his opponents, he thought) on the day of the poll, and this undoubtedly kept many of his most ardent supporters at home. But surely the false alarm worked trilaterally. I myself, for instance, would, in all probability, have voted for Sir Willington, had I considered it safe to go to the polling-booth.

Ruthless Rhymes.

WHILST chasing Huns upon his Camel,
The Sopwith kind, and not the mammal
Reggie over-did a bank.
His head quite spoilt the petrol tank.

! ! !

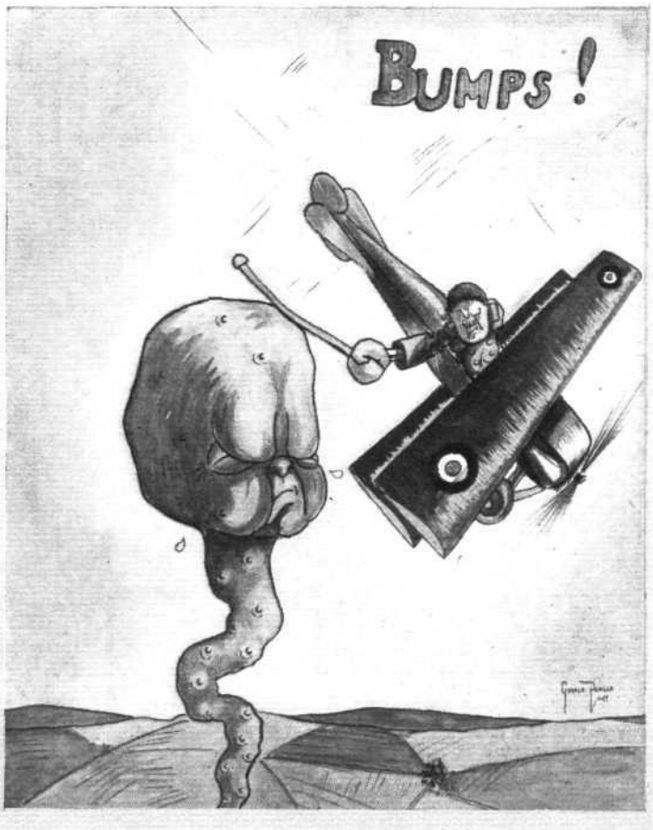
Fritz, upon his Gotha Raider,
London for a bee-line made-a;
Empty now is Fritz's garage.
Have you seen our A.A. barrage?

! ! !

It took young Clarence just a week
His aircraft park in France to seek,
For, fitting out his Martinsyde,
They did not put a chart inside.

! ! !

Horace on a B.E. 2 c,
Eloped one night with cousin Lucy;
He did not wed that daring wench.
They landed in a German trench!



Limericks.

LARGE and marvellous is the Caproni,
Even young ones appear over-growni.
If they get any bigger,
What price the poor rigger!
Unless they are braced by Marconi.

! ! !

A pilot who'd learnt on a Blériot
Always thought he was rather a heriot,
Till someone cried
"Steaduet,
I learnt on a Breguet."
Then his pride sank to somewhere near Zeriot.

! ! !

Whilst rigging a 'bus, an A.M.
Said, "Golly, this 'bus is a gem,
Gott strafe its designer,
I cannot align 'er,
I must wangle the angle *pro tem*."

AND it came to pass in the third year of the great war that the people of the land of Eng did cry out with a great voice, saying: Behold it is not well with them that fly. For they are as sheep before the shearers when they must meet he whom we call the Hun, for that the House of the Air is an house divided against itself, wherein of the red robe and the blue men say that each mattereth not to the other. And they lifted up their voices and cried to them in authority over them: Give us, we pray thee, an House of the Air in which there shall be no more strife, and where no man's hand shall be against his fellow.

And, behold, the cry which went up was so great that Herbert, who was the chief counsellor of the King, took counsel with his fellows and said unto one Nathaniel: Lo, it is for thee to square up the mess in this, the House of the Air. And Nathaniel answered and said: But, lord, wherewith am I to do this thing, since thou givest me no authority over these people of the Air? And Herbert, the chief counsellor, made answer with rude gestures and said: Go to, knowest thou not that this that we do now meaneth nothing, and is but to soothe the clamour of them that cry out in the public places?

So it came to pass that Nathaniel betook himself unto the House of the Air, and said unto those who dwelt there: Do thou this. But they laughed him to scorn and said: Who art thou, anyway, and where is thy authority without which no man can cut any ice in the land of Eng? For that was the manner of speech in the land of Eng in that time. And Nathaniel went forth into the market place and cast dust on his head, saying: Woe is me that Herbert hath let me down in this way.

And in the fulness of time the people of the land of Eng cried out against Herbert, and said: Behold, we are fed up with thy ways. Thou didst tell us aforetime to wait and see. Lo, we have waited and watched until our eyes be sore, but we have seen nothing. Get thee hence from the high places, and give us a man who will hustle with an exceeding great hustle. And Herbert got, and in his place one Jarge, who was of the county of Limehouse, became the chief counsellor of the King.

And after many days the people cried unto Jarge, saying: Behold, thou hast done well, but still there is the matter of the House of the Air which progresseth not. Wotabartit? Which again is after the speech of the people of the land of Eng. So Jarge gat him busy and sent for Dra-cow, the son of Peerzon, who was one of the King's builders of bridges and of aqueducts and all manner of great works in the land. And he said unto him: Lo, there is a great strafe in the House of the Air, in which the hand of all men is raised each against the other. That mattereth not a circumstance, save that the people cry out for the blood of them in authority, saying: Do something or get! And, behold, Al-fred, the maker of cabinets, of whom thou knowest aforetime, hath even an eye upon us, and the writing is upon the wall. Therefore, I pray thee, see to it that the strafe ceaseth, and I will give thee certain authority wherewith to still the clamour of them that dwell in the House of the Air.

And Dra-cow did even as Jarge had said, and the people declared one to another: Verily, this is a good egg, this thing that Jarge hath done.

But it came to pass that certain of those who sat in the councils of the land of Eng and certain of the scribes who had cunning in the ways of them that dwelt in the House of the Air, said: Yea, even though this be good that Dra-cow doeth, yet it is not enough, for is not the House of the Air divided within itself even unto this day? Wherefore, then, do ye not make one house and place over it one skilled in counsel and of great cunning in the ways of men?

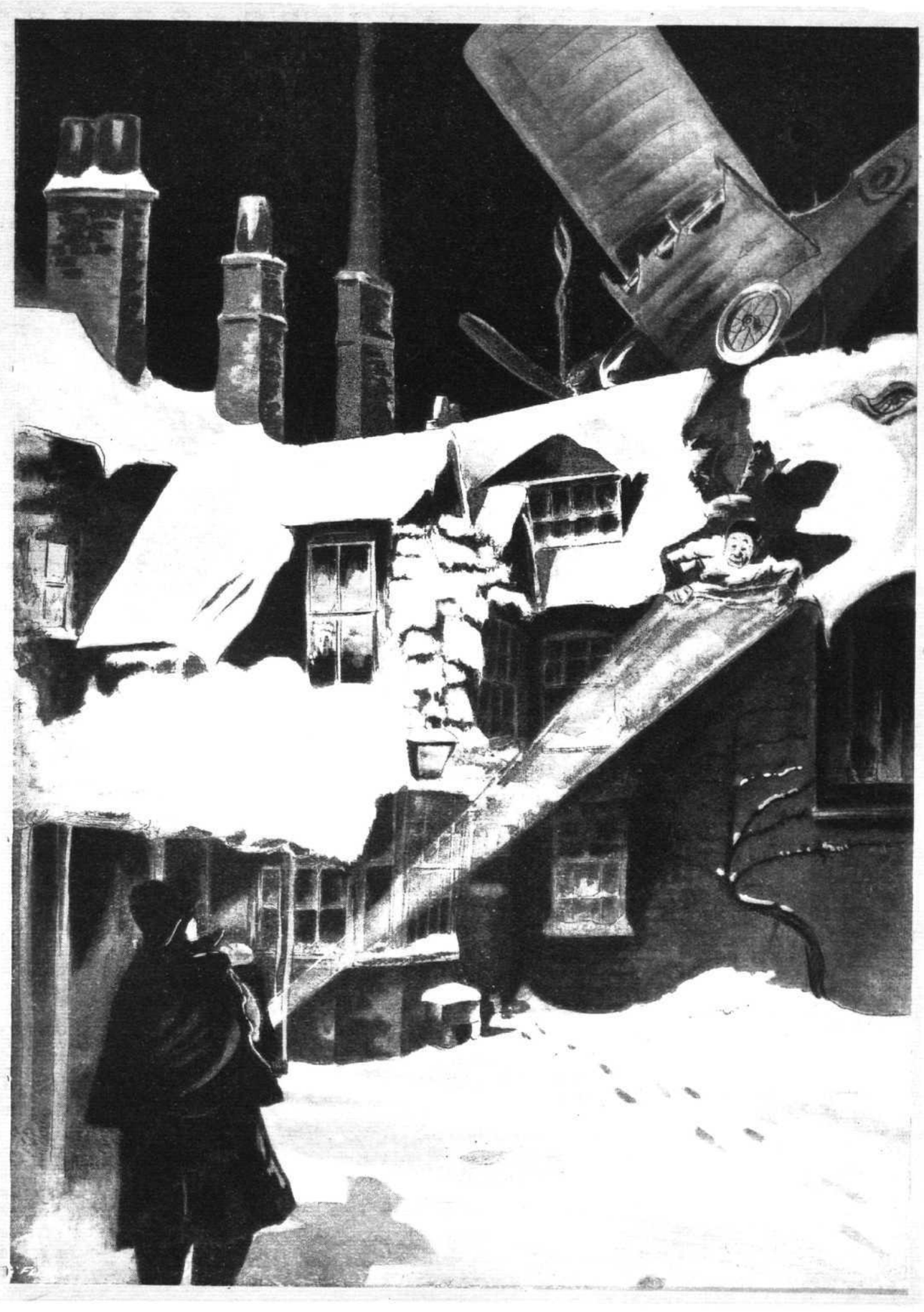
And there was one among the scribes who cried as a voice in the wilderness: What expect ye from an house like that of the Air, where all men have each his own end to serve and where even are the dwellers clad in all kinds of divers raiment and each weareth the symbol he loveth best. Give us, we pray thee, an house where all men are clad in one garb and where all weareth one symbol of their servitude to the King.

And, behold, all this seemed good in the eyes of Jarge and the counsellors of the King, and it was even so. Then Jarge spake unto Al-fred, the maker of Cabinets, who had returned to the land of Eng from a far country, saying: Lo, get thee to the House of the Air, where thou wilt find things for thy hands to do. But Al-fred winked him his dexter eye when the words of Jarge smote upon his ears, and said privily unto himself: Am I a fool that he should seek to muzzle me thus? So Al-fred, the maker of Cabinets, took him his tablets and wrote unto Jarge saying: Behold, there is nothing doing. And he also sent these words which he had written unto Jarge to the public scribes and the tellers of tales in the market places of the land of Eng, and these told unto all men of the writings of Al-fred.

And when Dra-cow heard of these things he was sore angered, but being of the race of them that are gentle he paraded not his anger, but said soothly unto Jarge: Behold, is thy servant a dog that thou shouldest do these things? And Jarge had no answer to these sayings. Now Al-fred, the maker of Cabinets, had even a brother whose name was Ha-rold and to him cometh Al-fred privily saying: Thou hast done well in the making of raiment and of trappings for the hosts of the King. Lo, tell me I pray thee, shall I speak unto Jarge that he shall set thee in authority over the House of the Air? For, he will do this thing if I counsel him, lest I say in the public places and in the writings that JARGE MUST GO. And Ha-rold made answer and said: Brother, thou art wise beyond the wisdom of all men. There is none among all the multitude of the counsellors of the King that is a circumstance unto thee. Yea, even the serpent hath not thy cunning. Let it be as thou sayest.

And behold, all these things came to pass in the land, even as Al-fred, the maker of Cabinets, had said. And Ha-rold entered into the House of the Air, and are they not written in the chronicles of the land of Eng the things that Ha-rold, the brother of Al-fred, maker of Cabinets, did at that time?

CYNICUS.



NOSE-DIVING.—Now then! none of yer playing Father Christmas up there. It's against the Defence of the Realm Regulations. *By Tom Morgan.*

THE LIONSTOOTH EQUATION

THE Professor was in a quandary. Of that there was ample evidence. He had twice called for tea, and the maid, realising, from experience, the hopelessness of arguing with a professor of aerodynamics, had deemed it politic to comply with the request each time; he had tried to do the same thing at dinner, but the cook was adamant, and brought up Lord Rhondda as a reserve force; he had tried to get into bed without removing his boots, and on being reproved had donned his dressing gown—inside out—replaced the offending boots by a pair of well-toasted slippers and betaken himself to the study. There he flung himself into his favourite armchair and murmured for about the fiftieth time that day:

"Assuming staggered monoplane values for a given maximum range of uniform acceleration, the gyration of bifocal vortices approximate the empirical basis of the conjugate functions influencing the velocity potential of the modulus of elasticity resulting in the diminution of sustentation of all evanescent cyclic components of phugoids of negligible amplitude."

"How absurd of Dr. Lionstooth to put forward such a statement! What abysmal ignorance! Was it possible that he did not know that the peripteral area of the hypothetical pterygoid section was asymmetrical?"

If only, the Professor thought, he could lay his hands on the equation which would prove his argument, he would write such a letter to the papers as would silence Dr. Lionstooth for ever and a day.

The Professor had been elected Honorary President of the Most Worshipful Guild of Integral and Differential Stress-Merchants, and so felt it incumbent upon himself to make his year of office a memorable one. This slip of Dr. Lionstooth provided an opportunity rich in possibilities, and he felt he must make the most of it.

What an historic occasion it would be when he delivered his Presidential Address. He pictured to himself the crowded hall with its rows and rows of hypercritical slide-rule manipulators eagerly drinking in every item of that precious flood of formulæ and equations. He saw himself covering blackboard after blackboard with figures, Greek letters and other hieroglyphics, but—unless he could lay his hands on that precious equation, it was but a day-dream.

Where could the all-important slip of paper—on which was written the wonderful equation—have gone? Two nights before he had thought it out, and, having carefully written it down, had put the piece of paper in a place where he knew its safety was assured. When morning broke, however, that slip of paper was missing, and try as he would the Professor could not reconstruct the equation. Yet he remembered that when he had written it down he knew he would never forget it because—yes, why was it he was bound to remember it? There was some simple clue which should have reminded him at once of the way it went, but the more the Professor rummaged in the corners of his brain the more hopeless did the search appear. That equation—and the simple method of remembering it—had the Scarlet Pimpernel beaten hollow for elusiveness.

For two days every nook and corner, every drawer, every pocket in the house had been turned out time and again—but to no purpose. The Professor decided to have one more attempt to find it, but after ransacking through his papers and every likely or unlikely place in his study, he gave up the search in despair and once more flung himself in the big armchair in front of the fire.

Having switched off the light, the Professor settled down, with his pipe, in another endeavour to try and think out afresh that jumble of figures and Greek letters on which so much depended. Gradually, however, his thoughts wandered away from aerodynamics to a much more pleasant subject. The same day as that on which he had worked out the equation he had been to a little lunch—a frugal repast the Chairman had styled it—which had been arranged to celebrate something or other, nobody seemed quite certain as to what it was about. It was, however, a very gratifying lunch. The hors d'œuvre had been specially pleasing to the Professor,

for he loved caviare. He was thinking how excellent it was, when he became aware of the presence of four curious little creatures, with big heads and little bodies, who lined up and, nodding to each other in the traditional glee-party manner, commenced to sing :—

We're singing in a row,
We are the b others ρ.
We're going for a row.
We're going to fish for roe.

This was followed by a curious mixture of sounds out of which emerged persistently, now and again, row, ρ, row or roe.

This went on for a few minutes, then suddenly ceased, and the brothers made a bow and disappeared. Then came forth a funny little, thin man, M. Upsilon, who would keep waving his arms about as if he wanted to fly. He announced that he proposed to recite a tale of woe. This was it :—

Miss Alpha, though she led her class,
Was yet a most unlovely lass,
She had a little sister θ,
And she would often bang and β
And push and punch and pound and pelt her,
And many a heavy blow she δ,
So that the kitten e'en would μ
When θ's sufferings she ν.

This Alpha was so bad to θ
That, every time she chanced to meet her,
She looked as though she longed to η,
And oft against the wall she jammed her,
And oft she took a stick and λ,
And for the pain and tear she brought her,
She pitied her not one ι,
But, with a sly and wicked eye,
Would only say, "Oh, fiddle! ϕ!"

Then θ cried with noisy clamour,
And ran and told her grief to γ,
And γ, with a pitying ψ,
Would give the little girl some π,
And say "Now, darling mustn't χ."

Two Irish lads, of ruddy cheek,
Were living just across the creek,
Their names O and ω;
The one was small, the other bigger.

For Alpha, so demure and striking,
ω took an ardent liking;
And Mike, when first he chanced to meet her
Fell deep in love with little θ,
And oft at eve the boys would go,
And on the pleasant waters ρ.

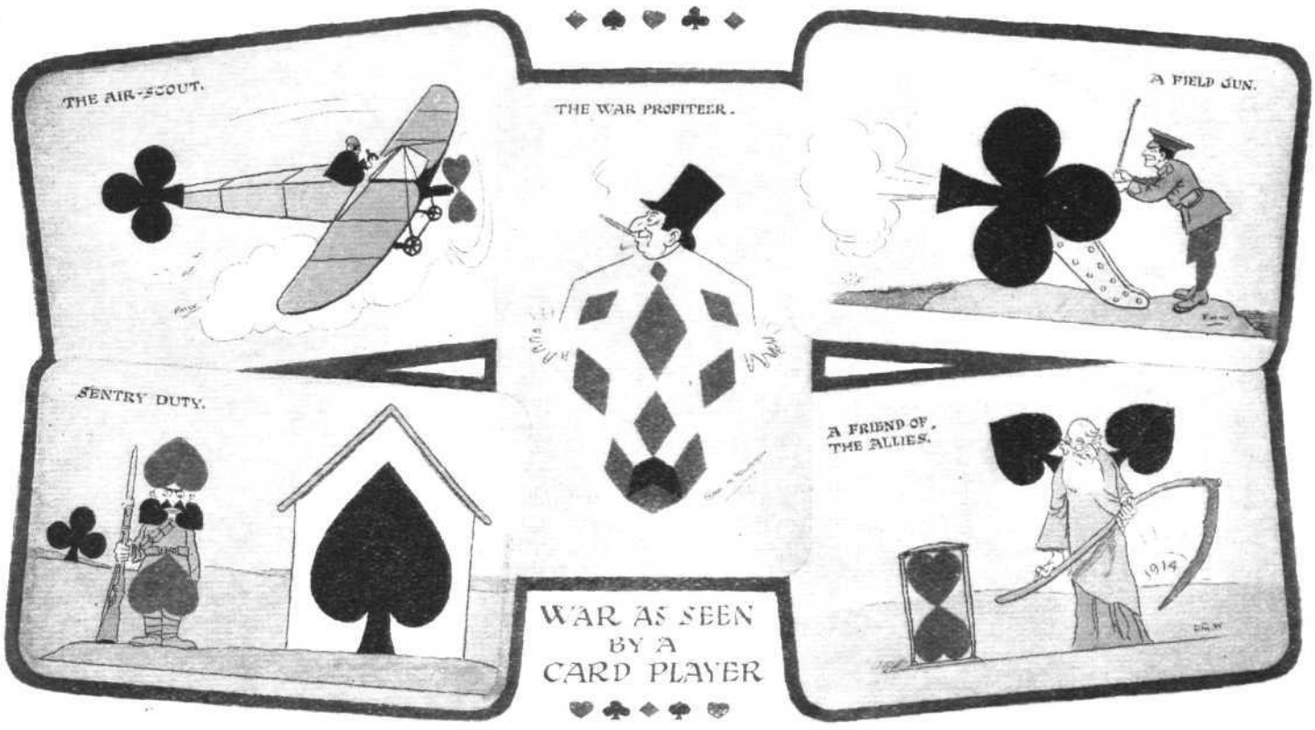
So when the hapless little θ
ν Alpha was about to β,
She down upon the bank would ζ,
And cry aloud and shout, like fun,
"Run Mike! run Mikey, O."

As the funny little man bowed and disappeared, the Professor realised with a start that this was none other than the device he had used when a boy at school to keep the Greek characters in mind. He recalled also that it was something of the kind which was to enable him to remember that all-important quotation. He even remembered that it started $\alpha\eta\rho$.

Jumping up suddenly from his chair in order to get paper and pencil, one of his slippers flew off and —lo and behold—out from it fell a crumpled piece of paper. The cleanness and freshness of the paper impelled the Professor to pick it up and investigate. Great was his joy to find it was indeed the note which by its absence had caused so much trouble and anxiety in the Professor's household for two days. How it got in the slipper was a mystery, but it had apparently been snugly reposing in the toe.

As for the equation, and the wonderful Presidential address which it inspired, nothing further need be said here, for are they not set down, together with the other doings of the Professor's wonderful year in the Transactions of the Worshipful Guild of Differential and Integral Stress-Merchants?

G. B.



The BLOOD-STAINED SPANNER OR THE MISSING MECHANIC.

By A.G.S. AXOL.

[*Editorial Note.*—With this week's issue of "FLIGHT" we start and finish our grand new thrilling serial by that young and brilliant author whose sundry articles have been appearing in fortnightly parts for some time past—Ed.

SAVE for the howling of the gale that raged without, and the regular beat of Captain (R.F.C.) Gaston Camouflage's heavy tread as he paced up and down the parky flooring of Lady Ima Chauviere's magnificent reception hall, and the irritatingly incessant tick-tock, tick-tock of Ima's Grandfather's clock, not a sound broke the deathly stillness of the night. It had just struck eleven. Would she fail him at the eleventh hour? Surely he had not done wrong in trusting her with the details of his secret mission, upon which so much depended? She would not, could not—Heavens!!—tell Count Kamerad! But no, he dismissed the thought almost before it crossed his mind, as a silvery laugh—hers—caused a deep flush to mount his handsome features at 3,000 ft. per minute. Again that laugh, somewhat high in pitch, and then she burst into the room. (Fig. 1.)

"Ima."

"Gassy."

For a moment he stood transfixed, gazing into her liquid French walnut eyes. Her design was indeed superb. She was some 5 ft. 4 ins. overall length, faultlessly streamlined, and her features were exquisitely carved, especially the entering edge of her chin. Her deeply cambered eyebrows and the negative washout to the corners of her mouth gave a dernière touche to her bewitching features. Her fuselage was covered with the finest quality fabric, supported thereon by expensively-jewelled bracing, and dyed with one of Messrs. Curate's world-famous art colours—a very fast cabbage pink. She had a stately and well-sprung under-carriage, that, as she taxied across the hall, produced a peculiar but none-the-less fascinating oscillation laterally. In her hair, which lay in disturbing eddies upon her head, she wore the famous Gotha diamonds set in a solid gold cabane—a wedding gift from Baron Emile Lyte de Titanine. Such were the goods that dumped themselves before his picture-orbits. (Oh, Henery! ED.) Unable to restrain himself he threw himself at her feet. (Fig. 2.)

"My love, at last," cried Gaston. "Quick, have you sealed the box I entrusted to your care? You must give it to me at once. In the courtyard below I have a special speedy scout in readiness, the Royal Aircraft Factory's latest combination of all the World's aircraft. Ah! my dear, you have no idea what a wonderful 'bus it is, nothing can touch it—even my trustworthy mechanic, A. M. Doaper, is not allowed to. It has a variable speed-range, and the weight has been cut down to a minimum, thus considerably reducing the centre of gravity. It is provided with an automatic wind-tunnel, which assures that the altimeter and air-speed indicator always show a constant reading, so that they are thus unnecessary impedimenta and are therefore eliminated from the machine's equipment.

"When taxying on the ground," shrieked Gaston, his eyes shining like Verey lights with enthusiasm, "the wheels are connected by bevel gearing to the engine, so that they keep the latter going, a six-and-a-half bladed fan, driven by the slip-stream from the wood-screw in front, function to the same end when the machine is in the air."

"Oh, Gaston," cried Ima in an awful whisper, "how wonderful. And does it really fly?"

But Gaston did not reply. He was thinking of his mother's cottage with the roses round the door.

"Yes," he mused, 50 per cent. aloud, 5 per cent. to her, and 45 per cent. to himself, "everything is in favour of a successful journey—— But come," he said, suddenly revving up, "I have not a moment to lose, but must leave for the front by the back way immediately. I have tarried too long already, for this is Monday, to-morrow will be Tuesday, the next day Wednesday—half the week gone, and still I have not delivered that precious box to the Mess at the Air Board. How can they do without it? Ah! my love, to think that only you and I know the contents of that box—half a pound of sugar!"

The last word was no sooner out of his mouth than, from the far end of the hall, came a triumphant "Ha!" having a decidedly foreign accent. A synchronised cry escaped, as if from Donnington Hall, from the lovers' lips. Gaston sprang to his feet and executed a sharply banked left-hand turn. There before him stood Count Kamerad. His head swam. (Fig. 3.) It was the first time he had seen this man, and yet—where had he seen that face before? Was it? Could it? Did it? Ptschza-wah! How could it be? Yet he was struck by the likeness. (Fig. 4.)

"Zo," thundered the Count in perfect naturalised English, "mein leedle vife, dat vare the sugar goes is?" He strode across the hall with a swinging gait. (Fig. 5.) He spiralled fiercely upon the unfortunate Gaston. "Go! Neffer darken these doors again," he ejaculated in short pants. (Fig. 6.)

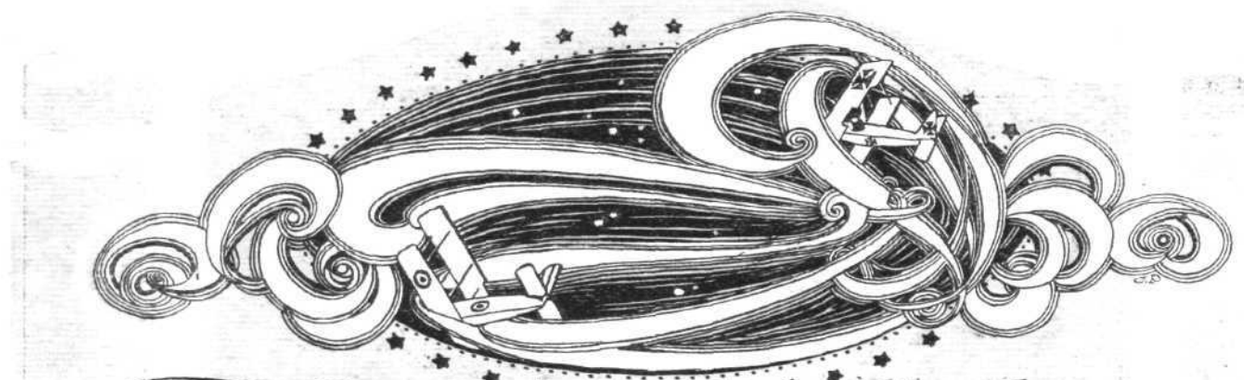
But Gaston had already left, and presently the unhealthy sound from the exhaust of his 20 h.p. Hispano-Fordini engine drifted in through the Triplex window. Then it suddenly ceased, and an agonised cry rent the same deathly silence that had still continued to dominate. The sole remaining occupants of the hall, including Lady Ima Chauviere and Count Kamerad, rushed to the door and nose-dived into the courtyard without. (Hurting themselves?—ED.) There stood Gaston, sitting in front of his B.C. 3001 biplane, his face like undoped fabric, and a blood-stained spanner in his hand.

"All is lost," he cried, "the engine is missing, and so is the mechanic." With that he fell against the machine, which was staggered. They gathered round his prostrate form, but, alas, too late!! He was Passed A.I.D.!!! V.J.

(*Continued on page* 6492.)

The Blood-Stained Spanner; or, the Missing Mechanic.

By H. Vernon Jones.



The frozen battleplanes.

A Christmas tale.

SQUARE, generous, but somewhat loosely built, Sandy, as his friends nicknamed him, was a breezy fellow. When Sandy entered a room, it brightened up with his presence. Balancing himself on his toes, for he couldn't keep still, or jingling the money in his pockets, he would spin yarns or sing coon songs far into the pale hours of morning, and on feeblest provocation he would break into "Amurrican" and lose many friends thereby. Even as a boy, Sandy was fond of performing anywhere and on anything, so when he grew up he took to flying as readily as he did to Manhattan-cobbler or to story-telling. When the war broke out, Sandy mounted the pilot's seat and soon gathered a halo of thrilling escapes and queer adventures.

Once on a frosty Christmas Eve, Sandy chased a German high above the clouds. It was a wild game, a furious catch-as-catch-can; so reckless that often the wing-tips of the machines would all but touch. All the time they were climbing higher and higher into the thin atmosphere. The wind whistled through the struts and wires. Minute icicles filled the air and dashed, like thousands of sharp needles, against Sandy's forehead.

The German banked heavily well over Sandy's head. Sandy instantly pushed the rudder bar to the right, but the rudder wouldn't answer; he wangled the "joy-stick," but the ailerons wouldn't move. He tried to aim his machine gun, but, no matter how savagely he struggled, the gun refused to turn. In rage Sandy shook the machine and hurled at it his richest adjectives, but to no purpose.

It seemed a lost game. His German rival was a dare-devil pilot, and Sandy couldn't have hoped to escape. He closed his eyes and counted the passing seconds, listening to the merciless German machine gun. Yet not a bullet came near him. Sandy was bewildered; it wasn't Hun-like to miss such a mean advantage. When he had counted up to ten he ventured to look up. To his amazement the German machine was still half-tilted over him, exactly as he had seen it before; but now it was shrouded in mist; gradually it became spectral and at last vanished altogether.

Faintly a few shots came after Sandy from the mist; then the rush of wind ceased and all noise died away. A strange opalescent fog spread all round him; and as the machine dashed through it, the fire-like icy crystals streamed in the lines of flight and froze into thin ribbons that followed each strut and wire in sinuous curves, spirals and waves, finally merging into one general form. Around the astonished Sandy was a prismatic definition of flight: an arrested crystallised movement of his flying machine, now completely frost-bound.

Sandy was imprisoned in this icy entanglement, and forthwith tried to escape it. With a heavy spanner he was quickly breaking ribbon after ribbon of this frozen labyrinth; so might a silk worm have bitten its way to light through the threads of its cocoon. At last Sandy lifted himself through the narrow cutting.

"Gee!" exclaimed Sandy as he stood in a huge crystal globe, a marvellous frozen air bubble, steeped in mellow amber of the evening sun. The icy sphere was slowly rotating, and Sandy's machine, like an exotic chrysalis frozen in its side, was gradually drifting away from him.

Huge mirrors of ice reflected whole series of grotesque misprints of Sandy, elongated, distorted, wholly laughable. From the depth of the lofty roofing, a large pale eye looked gravely at him, like the emblem of the sun-god of the ancient Egyptians. On long icicles, on smooth glass-like surfaces, the sun glistened in thousands of images of itself in colours more dazzling than Aladdin's charmed jewels. Each patch of colour had its outline in rainbow; each aurelian pear-shape drop had its setting in wonderful blues and emeralds; and there were deep recesses of aquamarine, glimpses into the dark openings of the sky. This strange, fantastic cavern of crystalline light was vibrating to slow rhythm of an old hymn and many icicles echoed the melody like silver bells.

It surprised Sandy and his adjectives: Were they angels? Was it hallucination? Was he dreaming?—he vigorously touched his head and hands to assure himself that he was awake and living.

At last Sandy sang out: "Say, stranger," and many a silver-tongued Columbus and Lincoln, Whitman and Roosevelt called back to him: "Aye, stranger!"

The wonderful music abruptly stopped, as if unwilling to mix with such worldly company; only the light and colours played in tense silence their bewildering symphonies, now deepening into crimson as it grew darker.

A harsh guttural voice answered him and a multitude of broken icicles clattered down like splinters of glass. Only now Sandy remembered his German, who at this moment began to slide down from the opposite wall, to which his machine was frozen, and missing his footing on the glassy surface, tumbled not far from Sandy. They instantly faced each other.

The uncouth and short-necked German fellow, looked, for all his insolent arrogance, almost ridiculous. Midway across his large dark face ran a deep scar, a life-long souvenir of his dissipated college days, of which brand of brutality the German was not a little proud. Carefully hiding a small, curious box under his arm, he appealed to Sandy, as Archimedes might have done to his slayers: "One moment," he said. "Sure," granted Sandy. The German turned away and jealously examined his box, fearing perhaps that it might have been damaged in his rough fall.

He turned to Sandy and stiffly drew out his revolver. Sandy was ready; yet it seemed odd, that they should fight in such a strange place. At last the German broke the silence: "Your aeroplane?" he queried. "Sure," replied Sandy. "A good target," said the German, and before Sandy could have collared him, he fired. Broken fragments of a long icicle noisily spattered against the icy walls. The Hun grunted. "My turn," shouted Sandy, and, advancing close to the German, he fired at the same icicle, hitting it about an inch higher than the German had done.

The German smiled awkwardly and lowered his revolver, Sandy would have liked to thrash him, and by way of introduction called him many a fine name, when, just then, something singular began to happen to the icy cavern. Gone was its clear crystal-like sound, that echoed every movement and every word; a stealthy, sinister haze swept across the surfaces of ice. The two aeroplanes noiselessly glided towards Sandy and his enemy. Sandy rushed to his and climbed into the seat, while the black-crossed machine was balancing itself perilously on its rudder, and the German was helplessly sinking through the softening ground. In despair he fired some dozen shots at Sandy, and that is the last that Sandy remembered with any distinctness. The whole icy edifice tumbled like a mighty avalanche, dragging Sandy and his machine in its fall. Some huge stretch of greyish white yawned far below Sandy! It became entangled with dark sky and stars that rushed past him in wild confusion, then all faded from his thoughts and memory.

When at last he opened his eyes, he was surrounded by a goodly company of kindly folk. It was a fine frosty morning, and before him opened a view familiar to him from childhood, and yet never before had he seen it in such fresh, clear newness: the snow-covered valley, closing up with the gently rising South Downs and the old, square-towered Sussex town; to the right, the huge chalk pit, now peach-coloured and overhung with snow.

A keen-featured doctor now for the tenth time repeated to Sandy that he was found in an unusually heavy snow-drift which saved his life. Sandy, as one in a dream, wondered why he should have been found in a snow-drift at all, when at that moment a youth came running down the avenue of snow-laden trees, and shouted that the machine was found some three miles further south. Instantly Sandy recollected all, and asked excitedly after the German, but no one could tell him. The doctor looked keenly at Sandy, and Sandy said nothing more.

At last quite a procession took the road, and slowly mounted the undulating ground. Sandy was too impatient to solve a mystery that troubled him. They took now a short cut across the snow, and at the top of a field the wreck of the machine came suddenly to view on the opposite ridge—the fuselage and the remains of the tail plane lifting darkly against the rosy sky, like some old, quixotic windmill. The youth jerkily stopped, then shrieked in terror: "There he is." The doctor shook him roughly: "Who, you young fool?" "The German." "You were right then," said the doctor, and Sandy nodded.

Sure enough it was the German. The doctor knelt to him, and handed to Sandy the box, which the German still protected under his arm; then he covered him with a rug.

They walked in silence back to the doctor's house, and there Sandy told the doctor this story and showed him the wonderful box. It was of delicate workmanship. On the sides and the lid, painted in rich colours and enriched with gold, were groups of angels, some singing and others accompanying them on strange instruments: they might have stepped out of some old Flemish tapestry; indeed, they might have been designed by Hanz Memling himself, so beautiful they were.

In this box was enshrined the homely melody that greeted Sandy in the crystal cavern, the Christmas hymn so familiar to the Scandinavian countries and the whole of Northern Europe. Sandy and the doctor listened to it for the last time.

When they buried the German, they also buried with him this curious box.

Of the German's machine or his revolver nothing was ever heard; perhaps they drifted further south and were lost in the sea.

Whenever Sandy repeated this story, the boys would plague him with: "What a pity you haven't kept that box," and Sandy began to think so too.

J. P.

Rag-time Yule-tide.

EVEN the Germans can't stop Christmas coming round. "Peace on Earth" is an old motto for which there is, at the moment, no sale, but there is still a plentiful supply of "Goodwill Towards Men," so long as they're fighting on our side. This being so, it is the obvious duty of all of us to endeavour to brighten the lives of those who are now busy bashing Boches. Our American allies deserve our special consideration, for this is, generally speaking, their first Christmas away from home, and they may be somewhat at a loss as to the correct British method of celebrating the festival. Their Fourth of July is an open-air event, happening as it does in the summer-time, though I fancy that, after a year or two of star-shells and all the other pyrotechnic effects for which Europe has become so justly famous, the old-style firework displays of Independence Day will decline severely in popularity. Thanksgiving Day, of course, is also a big event in the U.S.A., but Christmas, I believe, attracts little attention.

It is necessary, therefore, that someone should step gracefully forward and offer them a few useful hints as to what to do on this notable occasion, and, as no one else seems to be doing it, I hereby step forward. My suggestions are mainly for the benefit of my friends in the American Air Service, who may, if the weather is sufficiently wintry, have a little spare time on their hands round about December 25th.

One ancient and popular custom is that of hanging up one's stockings overnight on the chance of getting them filled with gold, frankincense, and very likely myrrh. This is mostly confined to the children, but grown-ups have been known to do it. Aviators,

however, will probably be wearing all the stockings they possess, if it's as cold as it was last Christmas, so we will pass on to the Christmas card.

It was formerly the custom to send out a few dozen cards bearing complimentary remarks from the sender to all those people from whom cards were received last year. A few bright lines from Tennyson or Wordsworth and a small illustration of a village church (before the bombardment), camouflaged in snow and holly, were usually included. Owing to the present shortage of paper, however, due to the enormous quantity of forms and circulars required by the Air Board and the Ministry of Munitions for the proper conduct of the war, it will probably be difficult to obtain any Christmas cards this year.

Under these circumstances we will pass on to the all-important subject of feeding. This is really the main feature of our Yule-tide festival. An elaborate menu, including the Roast Beef of Old England (as advertised in all the old ballads), turkey, plum-pudding, mince-pies, walnuts and wine, has been the custom, as novelists say, from time immemorial, and this pleasing and convivial item should delight our friends from across the Atlantic. But, now that I come to think of it, I believe the Food Controller will probably interfere with that idea, in which case all that remains will be to wind up the day with some sort of entertainment.

The usual Christmas songs and recitations are hardly appropriate, so perhaps some of the popular songs of the day might be substituted. And as the words, with all due respect to their authors, are frequently of a too sentimental or parochial nature, mostly turning on the desire of someone to be back in some place with a name which happens to rhyme conveniently with something else, I think it would not be difficult to flavour them with a little dash of aviation. Here are a few samples:—

[*Special Note.*—DON'T READ THEM—SING THEM.]

Tune: "My Old Kentucky Home."

I've got a sneaky feelin' round my heart that I want to bomb a town.
I guess I'll pack my grip and take a trip where I might drop somethin' down.
Now I'm helpin' in this war
I'll give Master Boche "what for!"
There's a lesson due to Essen,
I'll be tickled to death to know
That I can fly right there over Fritzy's happy home.
I guess I'll make a fuss on my Detroit 'bus
With my new Kentucky Gnome!

[This does not necessarily mean that the Gnome motor is now being made in Kentucky. I put that in to mislead the Huns. Also because it rhymes.]

Tune: "Way Down in Tennessee."

Way down in Tennessee
Just try to picture me
Doing my first v.p.—
It put the wind up me.
All I could do was keep hold, and forget what I'd been told,
My knees knocking something shocking,
Both my feet felt cold.
The roses round the door
Appealed to me no more,
I saw my stern C.O.
And friends I used to know,
And they were right there to meet me—
You should just have seen them greet me—
When I flew back—yes, I flew back
To my home in Tennessee.

[Excuse my interrupting again for a moment, but I want to make it clear that I do not mean to indicate that a training depôt for Zepp.-strafers has been established in this well-known locality. One has to be so careful of these D.O.R.A. Regulations, and I should hate to give information to the enemy—unless I knew it was wrong.]

Tune: "You'll Always be the Same Sweet Baby."

You're my precious little Sopwith,
You are all the world to me,
You're the kind of 'bus to stop with.
(N.B.—I couldn't avoid that rhyme.)
And when the weather's warm and you feel in form
There's oh! oh! oceans of climb in you.
When the Huns are round about me
Life is not too full of glee,
But when my motor's dud and the Archies burst
Till I get cold feet and an expensive thirst
You'll always be the same old Sopwith to me.

Tune: "The Long, Long Trail."

There's a long, long raid a-coming
Into the land of the Huns,
Where the Eau-de-C'logne is humming
And where Krupps make guns.
It's a long, long time we've waited,
And we've behaved far too well.
But now we're going to give those Germans
What Lloyd George called—"Hell!"

Tune:—"Dixie."

I come from Dixie—I said from Dixie,
In the land of cotton I learned to fly.
To land in cotton is pretty rotten,
And I've often gotten cotton in my eye.
But flying to a rag-time tune is all the rage,
I take up lots of niggers in my Family-Page,
They sing with fervour, and my observer
He sings of Dixie too.

[If I may butt in again for a second, I would like to draw particular attention to my new name for the Handley-Page. In view of its marvellous passenger-carrying records I think I've found a good one. But let the music proceed.]

Tune: "Every Little While."

Every little while I hear an Archie,
Every little while a bit goes through.
My fabric's tearing—I can't help swearing,
The sky is bright blue, and I'm blue too.
(With the cold and with funk, lor' love yer!)
Every little while I think they've got me,
Every little while I hate their style,
(Now I'd like to be home!)
And while I keep on flying through it
I wish they wouldn't do it,
But they may keep missing all the while.

Tune: "When You're All Dressed Up."

When you're all dressed up and your motor won't go,
Life seems weary, dreary and slow,
You get an aching head and bad words are said
When you've nowhere to go, unless it's back in the shed.
And when your Flight-Commander comes on the field
To the spot where your big 'bus has been wheeled
And says, "Why—ain't you gone?" Your answer is "No!
I'm all dressed up, but the motor won't go."

Tune: "It's a Long, Long Way to My Home in Kentucky."

It's a long, long way to the middle of Potsdam,
Where the Kaiser hangs round the old palace door;
It's a long, long way, but when once we get started
With our T.N.T. we will give him "what for!"
So, weep no more, my Wilhelm,
Just push those beers away.
It's a long, long time we've been talking about it,
But we're bound to get there some day!

And, in conclusion, a sample verse and chorus from "The Broken Doll," as it might be sung by a pilot who has just returned from a flight over the lines, with a new gunner-observer, who looks pretty, but can't shoot for nuts:—

I wonder why I always fly the way I do,
But now it seems that all my schemes go wrong through you.
I used to bring the Boches down in days gone by,
But all that now is changed somehow—I wonder why!

Chorus:

You climbed into my 'bus an hour ago,
I thought that you looked very nice to know;
You said you could shoot well—I thought you knew,
Though I've had dud observers long before I met you.
The Huns kept flying round us all the while,
But you missed every one by half a mile.
If that's your form to-day, I am sorry to say,
You're as useful as a Broken Doll!

Well, there are a few suggestions for you, and I hope they will inspire some budding song-writer to try and go one better—for I cheerfully admit it might be done. To the American Air Service I say, "Welcome to Europe! Have as merry a Christmas as you can. Sing while you have the chance, for there's heavy work ahead of you. We are counting on you to help to end this horrible war, and when it's over we'll sing rag-time and any old thing you like, however rotten the rhyming!"

DOUGLAS W. THORBURN

Take cover!—"What, would *you* do?"

By Tom Morgan.

Why He was Apprehensive.

SANDY MACTAVISH was a highly skilled workman in a new aircraft factory.

Therefore, it happened one day that Sandy was asked if he would care to accompany the works aviator on one of his trial flights in a machine.

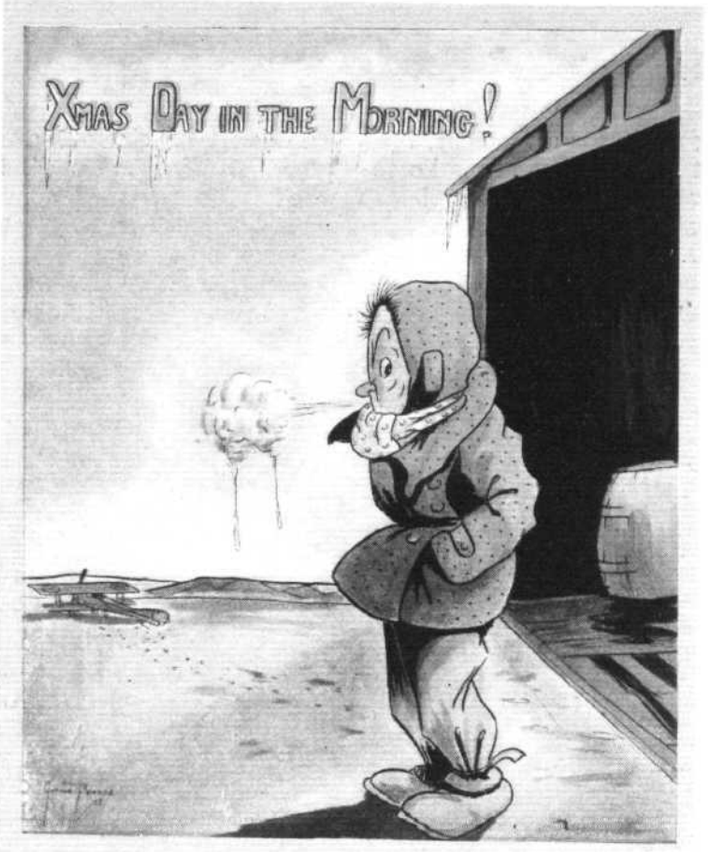
Sandy, after some hesitation, agreed to do so.

During the flight the aviator asked how he was enjoying it.

"To tell the truth," answered the Scot, "I wad rather be on the groun'."

"Tut, tut," replied the flying man. "I'm just thinking of looping the loop."

"For Heaven's sake, don't dae that!" yelled the now very nervous MacTavish. "I've some siller in my vest pocket."



Exposing His Ignorance.

LANDSMAN: "What's the horse-power of that engine you're running?"

JACKIE: "It's got no horse-power. Can't you see it's a donkey engine?"

! ! !

Essential.

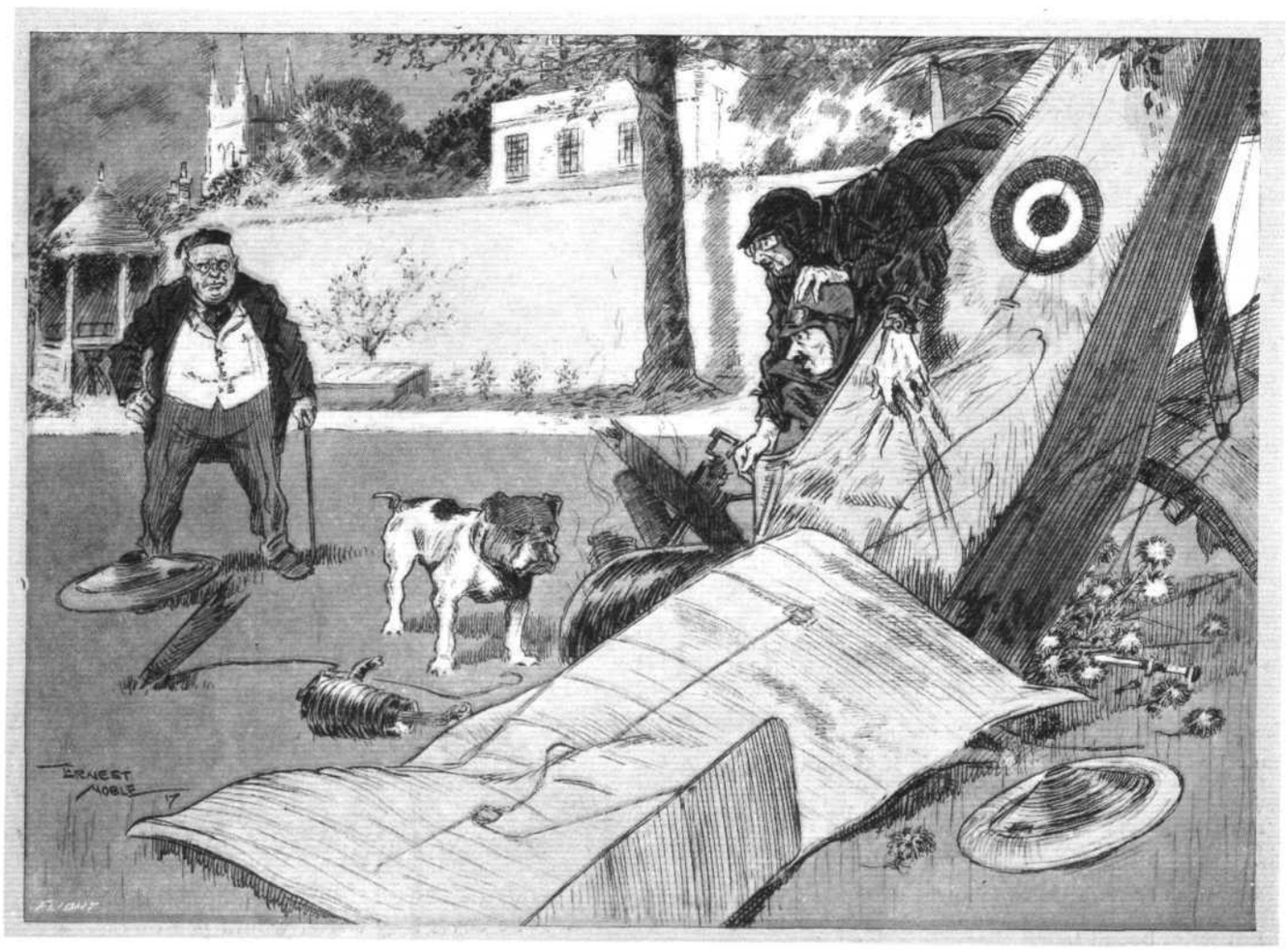
THE novice was not enjoying his first trip through the air, and his more experienced companion regarded him in some amusement.

"I say, Bill, what's on your mind?" he demanded.

"I was just thinking about Abraham Lincoln," replied Bill thoughtfully.

"Abraham Lincoln?"

"Yes. I was thinking how truthful he spoke when he said a man's legs ought to be just long enough to reach the ground."



Irate old gent.:—"Watch 'em, Boxer, mind 'em! while I go for a special; they're 'Uns. No one but 'Uns go and deliberately smash a man's chrysanthemums." *By Ernest Noble.*